IN INDUSTRY • IN TRANSPORTATION • ON THE SEA • IN THE AIR

DIESEL PROGRESS

To our over One Hundred Thousand regular monthly readers

we extend our good wishes for a Merry Christmas and a

Happy, Healthful and Prosperous 1951. This current year

has been good to us. The magazine has grown in stature,

in acceptance and, thanks to you our readers, we go into 1951

full of enthusiasm and a determination to do an even

better job.

EDITOR AND PUBLISHER

FIVE DOLLARS PER YEAR DECEMBER, 1950 FIFTY CENTS PER COPY

MORE GREATER ECONOMY

Texaco Ursa Oils reduce maintenance costs

Your engines – Diesel, gas or dual-fuel – are designed for power. *Texaco Ursa Oils* are designed to help them deliver that power. These famous oils resist oxidation, stand up under heat and pressure, and keep engines clean. Rings stay free, ports stay open, and valves function properly.

Better compression and combustion . . . smoother operation . . . minimum wear . . . all are assured with *Texaco Ursa Oils*. This means longer life for bearings and all moving parts . . . lower maintenance costs and less fuel consumption.

Texaco Ursa Oils are available in proper vis-

TUNE IN . . . TEXACO presents MILTON BERLE on television every Tuesday night. METROPOLITAN OPERA radio broadcasts every Saturday afternoon.

TEXACO

TEXACO

DIESEL PROGRESS for December, 1950. Volume XVI, Number 12. DIESEL PROGRESS is published monthly by Diesel Engines, Inc., 816 North La Cienega Boulevard, Los Angeles 46, California. Rex W. Wadman, President. Subscription rates: $5 per year, single copy 50c. Acceptance under 34.64, P. L. & R., authorized.

POWER

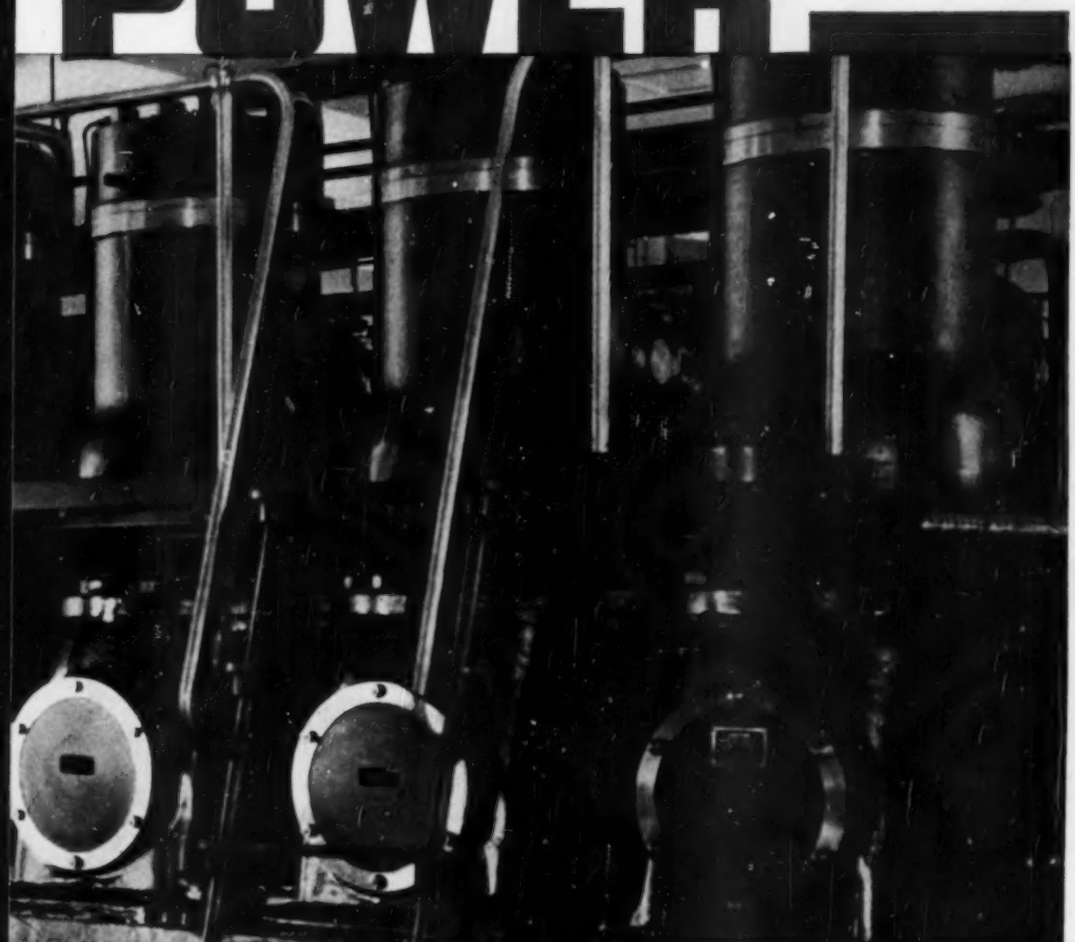


Photo courtesy Fairbanks, Morse & Co.

cosities for every need and are approved by leading Diesel manufacturers. They are America's favorite. For instance, in the Diesel field:

★ ★ ★

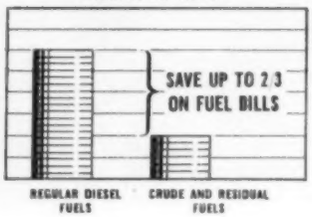
More stationary Diesel h.p. in the U.S. is lubricated with Texaco Ursa Oils than with any other brand.

Let a Texaco Lubrication Engineer show you how *Texaco Ursa Oils* will protect your Diesel investment. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

URSA OILS FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

The ability of Enterprise Diesels to burn crude and residual fuels, provides operators with a broad selection of inexpensive fuels for highest performance at lowest cost. Wherever distillates are hard to get, or too costly, this fuel flexibility becomes a more important factor than ever. The simple addition of suitable fuel oil heaters and centrifuges is all that is necessary. No change is required in the basic fuel injection system, and Enterprise Diesels operate smoothly and efficiently on heavy fuels at *all* speeds and loads without fouling. For full information on the proper fuel selection, be sure to get in touch with Enterprise . . . and for smooth performance on low cost fuels, make your next diesel Enterprise.

ON ALL ENTERPRISE MODELS FROM 68 TO 1755 HP



Enterprise
STATIONARY
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The Choice of Power Experts

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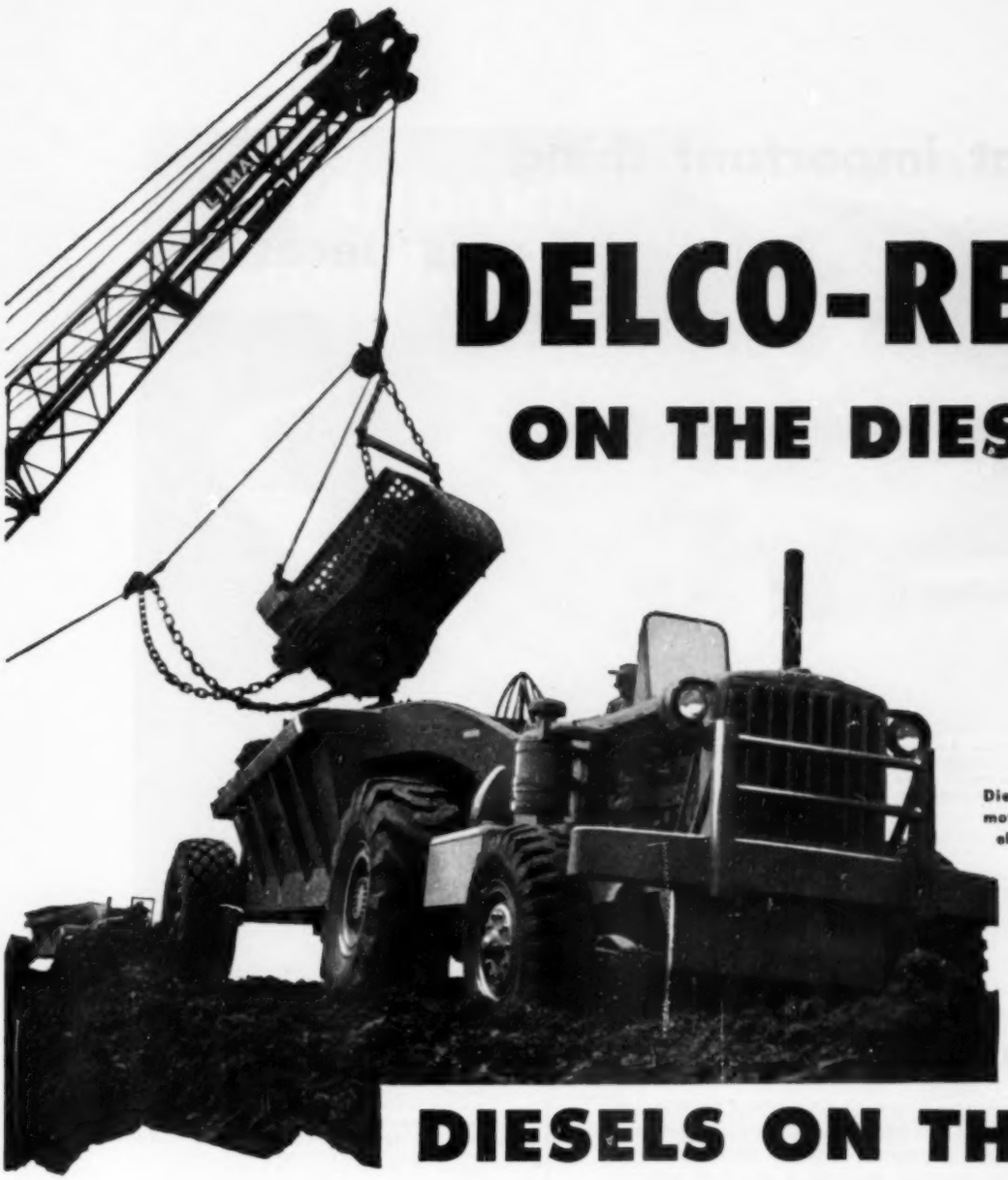
DELCO-REMY
ON THE DIESELS



Diesel-powered earth mover with Delco-Remy electrical equipment.

DIESELS ON THE JOB

Many of the toughest earth moving and other heavy construction jobs today are performed by Diesel-powered equipment.

On this Diesel, as on so many others where maximum efficiency and dependability are essential, you will find Delco-Remy Diesel electrical equipment.

Delco-Remy on a Diesel is a combination that you can count on for full, reliable performance.

UNITED SERVICE MOTORS

DELCO-REMY—A UNITED MOTORS LINE
Service Parts and Delco Batteries
Available Everywhere Through
UNITED MOTORS DISTRIBUTORS

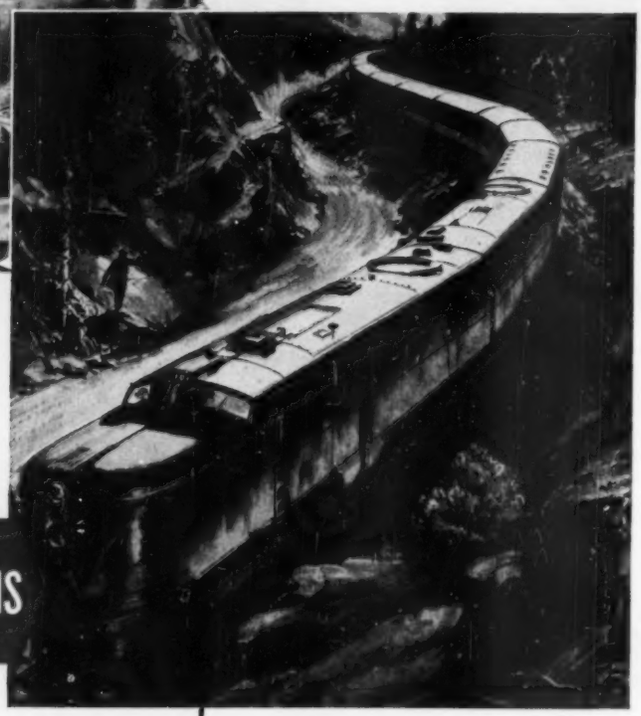
Delco-Remy
DIVISION, GENERAL MOTORS CORPORATION
ANDERSON, INDIANA

DELCO-REMY • WHEREVER WHEELS TURN OR PROPELLERS SPIN

What *important* thing

was necessary

to change THIS



to THIS

On mountainous terrain of a major southern road, 16 4-unit Diesels now handle the tonnage formerly hauled by 100 of the road's heaviest steam locomotives.

Dependable Fuel Injection

Diesel power was already *available* when most of the steam locomotives in use today were being built. But it was a sleeping giant. One vital element was necessary to make this efficient, economical source of power universally applicable — *dependable solid fuel injection equipment.*

American Bosch pioneered in this field. Constant development and field engineering, meticulous craftsmanship and precision manufacture, and a world-wide network of authorized service stations have maintained American Bosch leadership . . . and given owners of American Bosch-equipped engines advantages no maker or user of Diesels can afford to overlook.

1.. Development and Field Engineering.

American Bosch engineering departments and laboratories work constantly to improve existing products, develop new ones such as the revolutionary single plunger multi-cylinder PSB Pump. American Bosch field engineers work hand in hand with engine and equipment manufacturers — from original design to test models and actual field operation.

2. Precision Manufacture.

The knowledge and craftsmanship that made solid fuel injection a reality . . . plus engineering research, proven techniques, unparalleled production and testing facilities (many of them initiated and developed here) . . . insure uniform adherence to the highest standards of accuracy and performance.

3. Service Organization.

In many U.S. cities and at strategic points throughout the world, American Bosch maintains an ever-growing network of authorized service stations. Staffed by personnel trained to factory standards, with factory-designed and built testing equipment, they are prepared to render efficient and reliable service whenever needed.

American Bosch

Dependable Fuel Injection for the Diesel Industry

AMERICAN BOSCH CORPORATION, SPRINGFIELD 7, MASS.

Magnetos • Generators • Voltage Regulators • Ignition Coils • Electric Windshield Wipers • Diesel Fuel Injection Equipment

STANDARD ENGINEER'S REPORT

DATA

PRODUCT Chevron Starting Fluid

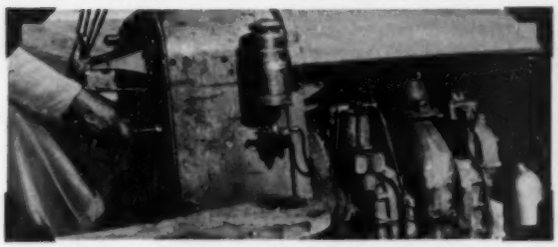
UNITS A.C. diesel engines HD-7 tractors

CONDITIONS 25° below zero weather—parked in open shed

EQUIPMENT Permanent primer with atomizers on blowers

FIRM John W. Graves Heppner, Oregon

Engine starts on first turn at 25° below zero!



CHEVRON STARTING FLUID started this engine instantly every time during a severe Oregon winter, even when the tractor had been idle for several days in temperatures down to 25° below zero! John W. Graves, owner, says, "Power in the starter battery would last only for two or three revolutions of the engine, but Chevron Starting Fluid required only one turn to kick it off." With one or two strokes of the dash-mounted pump, fluid was forced from the storage tank (left center) into the "blower", before the starter button was pushed.

ATOMIZER NOZZLES, as shown on this diesel "blower", are also used to inject Chevron Starting Fluid into intake manifolds of gasoline engines. Complete primer equipment may be purchased from your fluid supplier. Chevron Starting Fluid comes in 3-pint cans, and capsules of two sizes—7CC's and 17CC's, packed 12 and 24 per can. It is approved by leading engine manufacturers.

How CHEVRON Starting Fluid Starts Gasoline and Diesel Engines Instantly

A. Atomizes in lowest temperatures and provides powerful, easily fired vapor in combustion chamber.

B. Pressure, or the weakest spark, fires mixture—turns engine and heats air for regular fuel mixture.

C. Contains lubricant and additives—prevent cylinder wear and ice formation in primer equipment.

HOT NEWS ON COLD ENGINES

FREE BOOKLET gives you more facts on Chevron Starting Fluid—shows where it should be applied in different type engines. Write or ask for it today.

CHEVRON STARTING FLUID

TRADEMARK REG. U.S. PAT. OFF

FOR MORE INFORMATION about this or other petroleum products of any kind, or the name of your nearest distributor handling them, write or call any of the companies listed below.

STANDARD OIL COMPANY OF CALIFORNIA • San Francisco
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Always first

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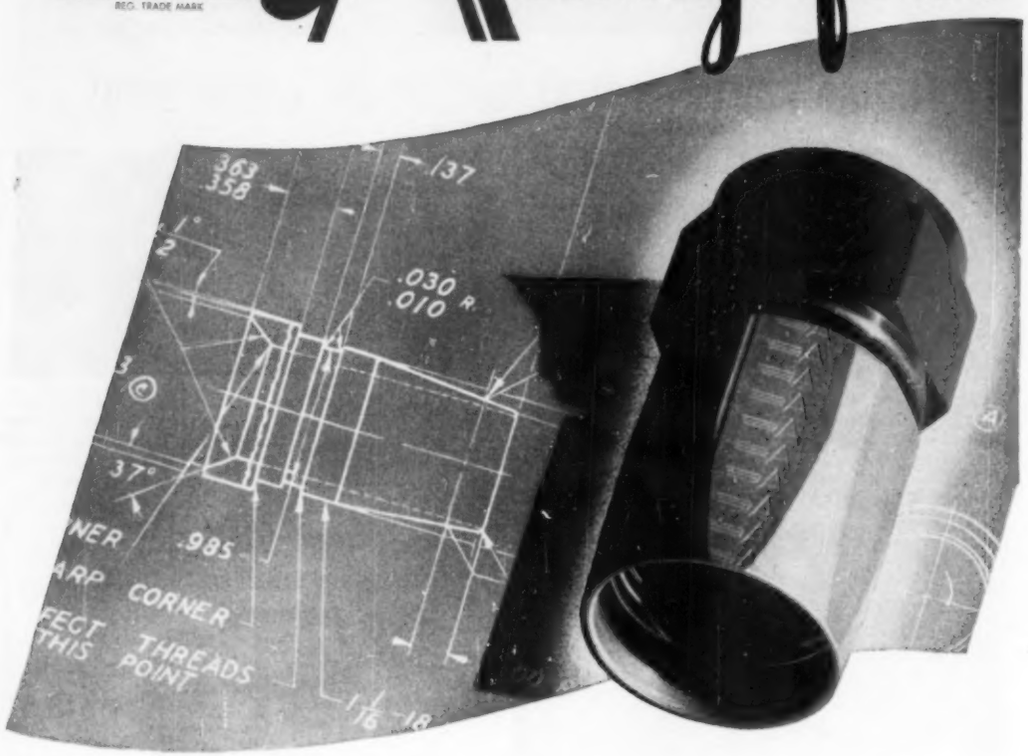

Conceived **FIRST**, *developed* **FIRST**, *produced* **FIRST**. **This is the undeniable record of AEROQUIP DETACHABLE, REUSABLE HOSE FITTINGS. Industry was quick to accept this new and original "Aeroquip Idea." Not only did industry adopt the "Aeroquip Idea," other manufacturers jumped headlong into the manufacture of products they hoped to substitute for Aeroquip Fittings. Imitation is the best form of flattery, but Aeroquip design and quality have never been equalled.**

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JACKSON, MICHIGAN

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AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U. S. A. AND ABROAD

LV Four Aces in Lehigh Fleet

New Lehigh Valley Railroad tugs —Lehigh, Cornell, Hazleton and Wilkes-Barre—lined up in New York Harbor.
Designer: Tams, Inc.
Builder: Jakobson Shipyard.

The Finest Fleet of Railroad Transfer Towboats in the World!

"Greater maneuverability, dependability and economy. Nothing to equal them in operation. Best for railroad harbor use," says Captain C. M. Moore, Marine Superintendent of Lehigh Valley Railroad, regarding their four new all-steel tugs powered with General Motors Diesel-Electric Drive. These tugs embody plans and ideas of the Lehigh Valley Marine Department.

Leader in Diesel engineering development for 38 years

Cleveland Diesel Engine Division

CLEVELAND 11, OHIO

GENERAL MOTORS

GM GENERAL MOTORS DIESEL POWER

ENGINES FROM 150 TO 2000 H.P.

General Motors Diesel-Electric Drive has powered more than 700 vessels in 22 different classifications.

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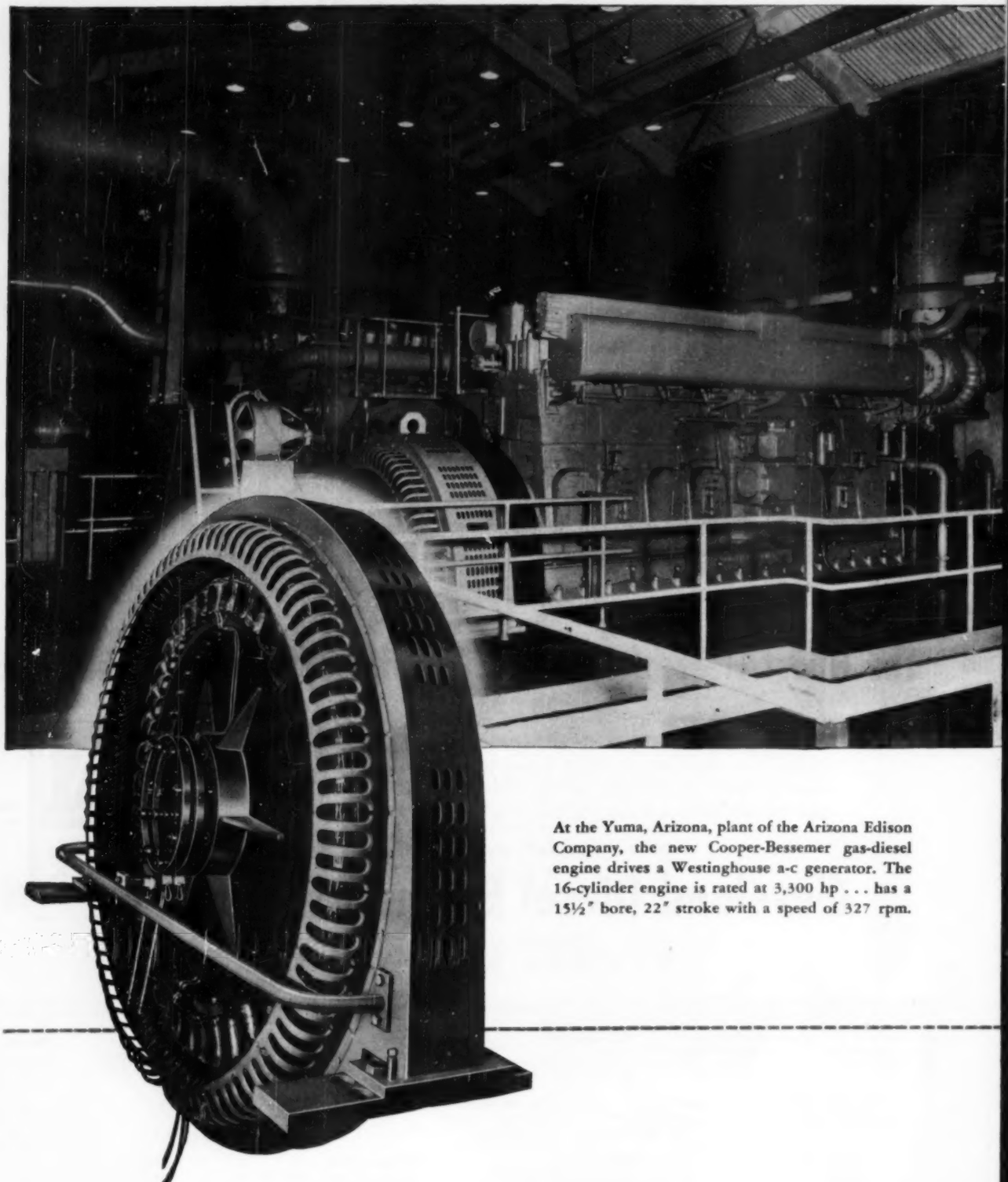
YOU CAN BE **SURE**.. IF IT'S

Westinghouse



At the Yuma, Arizona, plant of the Arizona Edison Company, the new Cooper-Bessemer gas-diesel engine drives a Westinghouse a-c generator. The 16-cylinder engine is rated at 3,300 hp . . . has a 15½″ bore, 22″ stroke with a speed of 327 rpm.

A Working Partner

FOR FULL-TIME, FULL-LOAD RESPONSIBILITY

It takes two to make a "power" bargain. Consequently, when the diesel builder was called on to provide a complete power unit, he chose an electrical partner that could match the full-load, around-the-clock performance of his 16-cylinder, gas diesel engine.

That's why you see a Westinghouse a-c generator coupled to the diesel. It has the inherent "sureness" of many years of practical experience of Westinghouse in design and construction of various types of alternators.

Every Westinghouse a-c generator is matched to the engine for lifetime operation. Each is built in the most modern and permanent form of construction—structural steel, fabricated with the electric arc.

For example: the fabricated steel rotors have a flexibility factor of practically zero and a maximum strength far in excess of that required to withstand the inherent pulsating torques of the engine drives. In fact, the rotors have been designed with such a high factor of safety, they are practically unbreakable.

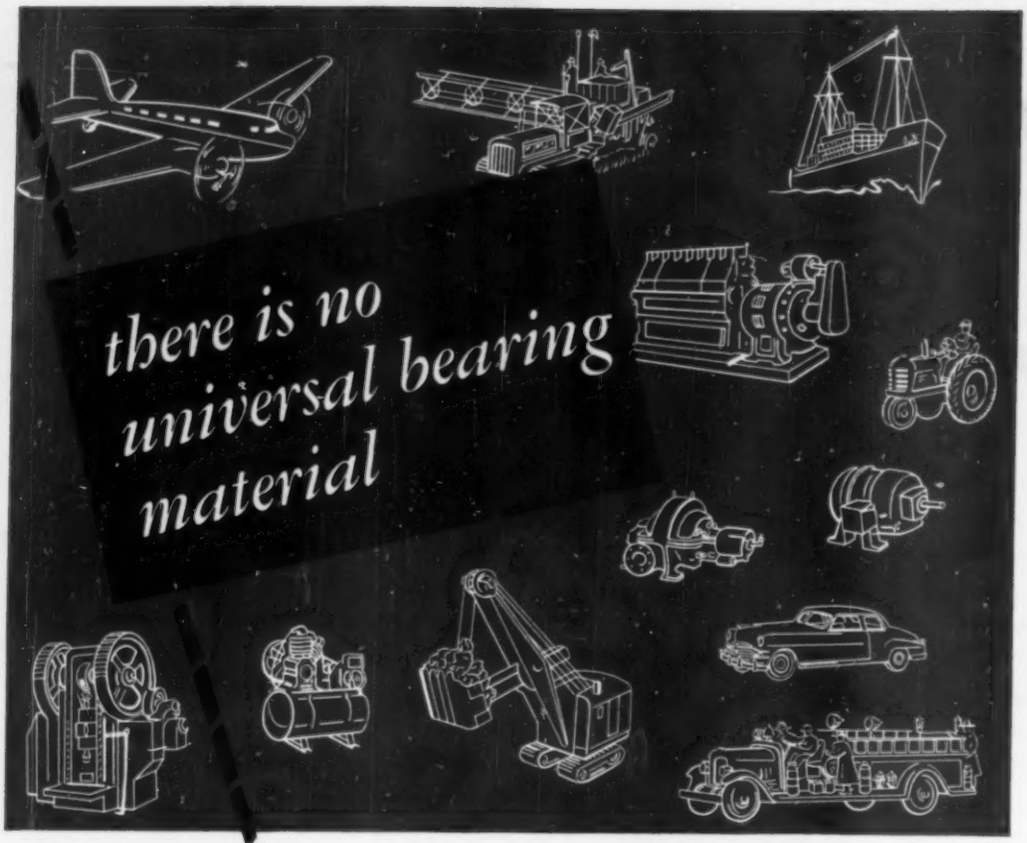
Today, many diesel engines of every leading diesel manufacturer are driving Westinghouse a-c generators. There is no safer way to assure lifetime satisfaction for your power plant than by specifying—"generator by Westinghouse".

Yes, you can be sure . . . of matched performance . . . of special engineering assistance . . . of adequate service facilities—if it's Westinghouse. Consult your nearby Westinghouse office for the services of a Power Apparatus Specialist. He will gladly assist you in planning power generation or distribution equipment. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-21586

Westinghouse

DIESEL ENGINE DRIVEN AC GENERATORS



Silent
SLEEVE
BEARINGS

12 MACHINES

How many different Bearings?

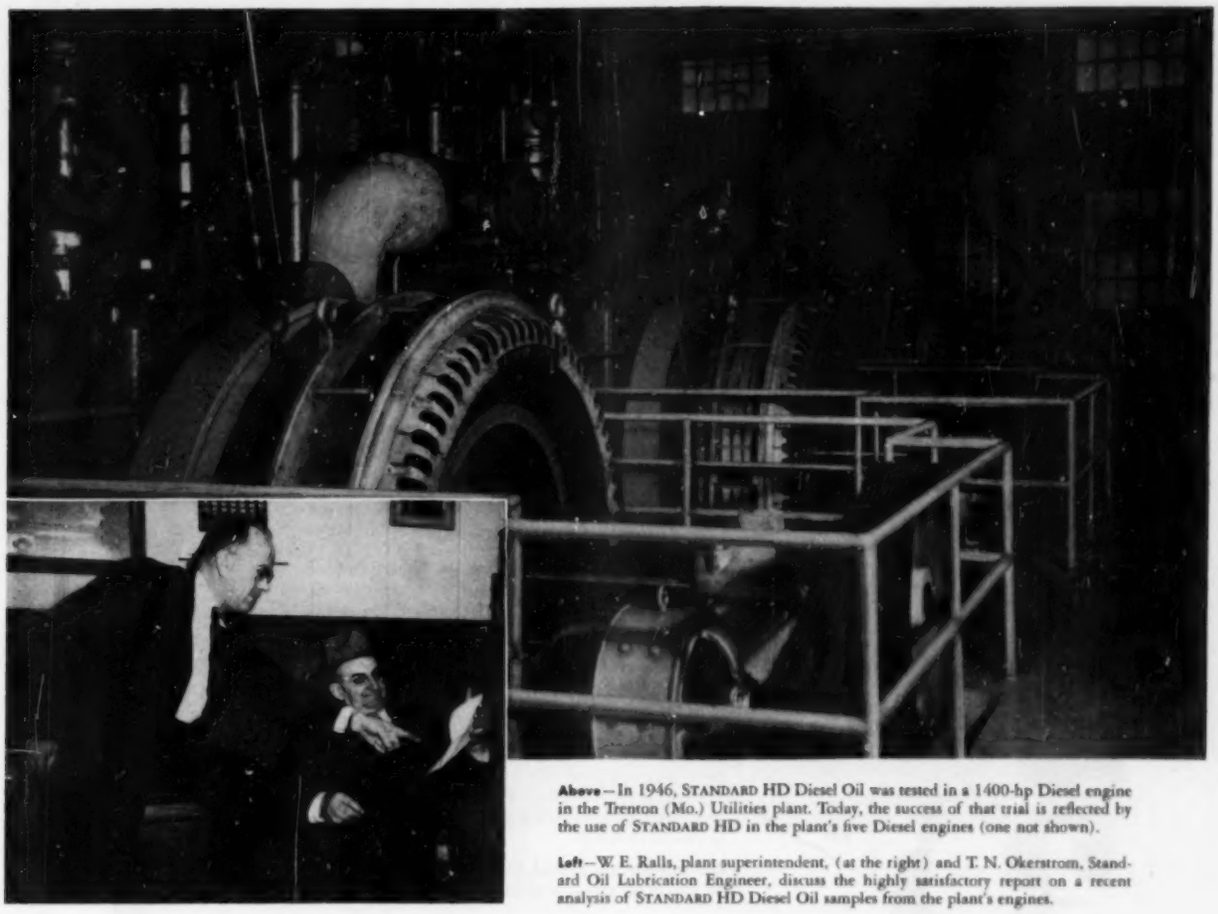
There may be 20, 40 or more variations and combinations of alloys and designs in the sleeve bearings. One engine may require different bearing alloys for main bearings, connecting rod bearings, camshaft bearings, piston pin bushings and water pump bushings. That's one reason why, as long-time specialists in research, design and manufacture of sleeve bearings, we specialize in *variety*. Our seven manufacturing plants produce sleeve bearings and bushings in a wide range of material combinations and sizes, in quantities from dozens to millions.

Send for handy Bulletin for your reference file. It shows the "field of usefulness" for a wide range of bearing alloys, and provides a ready reference on bearing applications for your library.

FEDERAL-MOGUL CORPORATION, 11039 Shoemaker, Detroit 13, Michigan

FEDERAL-MOGUL

OVER FIFTY YEARS OF CONTINUOUS BEARING EXPERIENCE



Above—In 1946, STANDARD HD Diesel Oil was tested in a 1400-hp Diesel engine in the Trenton (Mo.) Utilities plant. Today, the success of that trial is reflected by the use of STANDARD HD in the plant's five Diesel engines (one not shown).

Left—W. E. Ralls, plant superintendent, (at the right) and T. N. Okerstrom, Standard Oil Lubrication Engineer, discuss the highly satisfactory report on a recent analysis of STANDARD HD Diesel Oil samples from the plant's engines.

One good job leads to another . . . and another . . . and another!

The experience of W. E. Ralls, Superintendent of the Trenton Municipal Utilities plant at Trenton, Missouri, proves once again that reduction of downtime and maintenance is the Diesel operator's way to judge lubricating oil.

After talking with a Standard Oil lubrication specialist about the advantages of STANDARD HD Diesel Oil, Mr. Ralls put the heavy-duty lubricant to a test in the plant's 1400-hp Diesel engine. STANDARD HD came off with flying colors! The clean and trouble-free operation of this unit sold the new lubricant right into the plant's three 650-hp Diesels. When a new 1600-hp engine was installed in 1948 that, too, was filled with STANDARD HD Diesel Oil.

Today, the success of STANDARD HD on one job after another in this plant is reflected in more reliable Diesel operation and lower maintenance costs.

Let a Standard Oil lubrication specialist help you find how STANDARD HD Diesel Oil can reduce maintenance and overhauls. You can reach him quickly and easily by phoning the nearest local Standard Oil (Indiana) office. Or, if you wish, write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD HD
TRADE MARK
Diesel Oil

STANDARD OIL COMPANY (INDIANA) STANDARD

Your Dollars Go Farther...

with MACK 3-WAY economy

For savings that may turn losses into earnings, you can't equal a diesel bus. But remember—there are three ways your operating dollars should go farther with diesels—and you get *all three* with Macks.

1

2

3

Your FUEL DOLLARS go farther with Mack: You get many more miles to the gallon—using cheaper fuel—with Mack diesels. Most modern in the field, Mack diesel bus engines are setting new standards in operating economy. Yearly fuel savings of over $1,000 a bus have been reported.

Your SERVICE DOLLARS go farther with Mack: You get maximum strength and simplicity with Mack diesel engine design ...requiring minimum servicing and easy re-education of maintenance crews. Moreover, Mack "Planned Accessibility" extends ease of inspection and servicing throughout entire bus.

Your INVESTED DOLLARS go farther with Mack: You get long-lived dependability with Mack diesel buses—less vehicle downtime, with a greater return on your investment. Mack makes more of its vital components—engines, gears, axles and bodies—than any other manufacturer. "Built like a Mack" means *built to outlast them all.*

Only Mack gives you balanced, 3-way economy...because only Mack blends 50 years of bus-building experience with 23 years of diesel development.

Rochester (N. Y.) Transit Corporation has recently placed in operation 25 Mack Diesel 45-passenger Buses.

BE PROFIT-WISE

modernize with

MACK MANUFACTURING CORPORATION
Bus Division
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Mack BUSES

outlast them all

Factory branches and distributors for service and parts in all principal cities.
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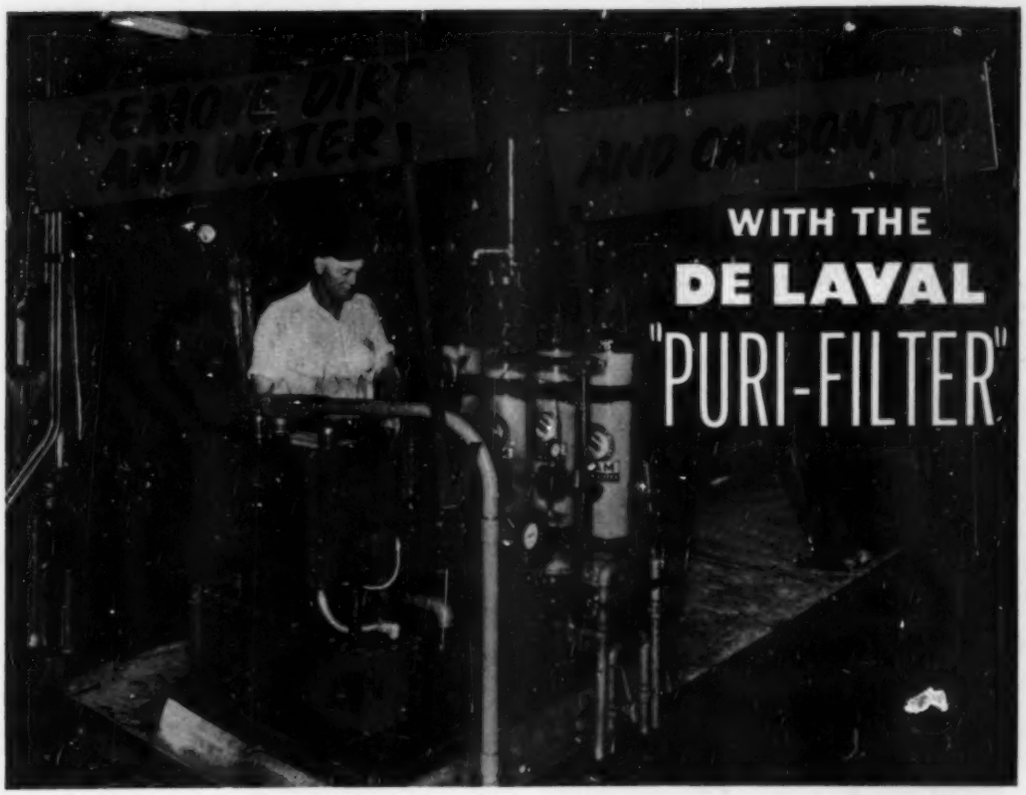

The De Laval "Puri-Filter" removes ***all three*** major contaminants of diesel lubricating oil: dirt, water and colloidal carbon. The first two are separated from the oil by centrifugal force in the bowl of the De Laval Oil Purifier—the water being discharged continuously. The colloidal carbon is then filtered out of the purified oil.

The De Laval "Puri-Filter" combines the De Laval "Uni-Matic" Oil Purifier and Fram "Filcron" filters. Because the combination unit gets rid of all contaminants down to one micron in size, and also keeps the oil completely free of moisture, it is the most effective means ever devised for protecting diesel engine bearings.

● Write for additional details on the De Laval "Puri-Filter" for diesel lubricating oil. Ask for Bulletin DL-1.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL *Oil Purifiers*
FOR DIESEL LUBRICATING OIL

"CYCLAN"

A new piston ring material for severe service in heavy duty diesel and gas engines

1. Cyclan is tough with plenty of tension but not brittle.
2. Twice the breakage resistance of ordinary ring iron.
3. Will not change structurally under heat.
4. Withstands impact, hammering, flexing without fracturing.
5. Withstands considerable distortion without losing shape.
6. Better wear resistance than standard ring iron.

Write for complete information.

SEALED POWER CORPORATION
MUSKEGON, MICHIGAN

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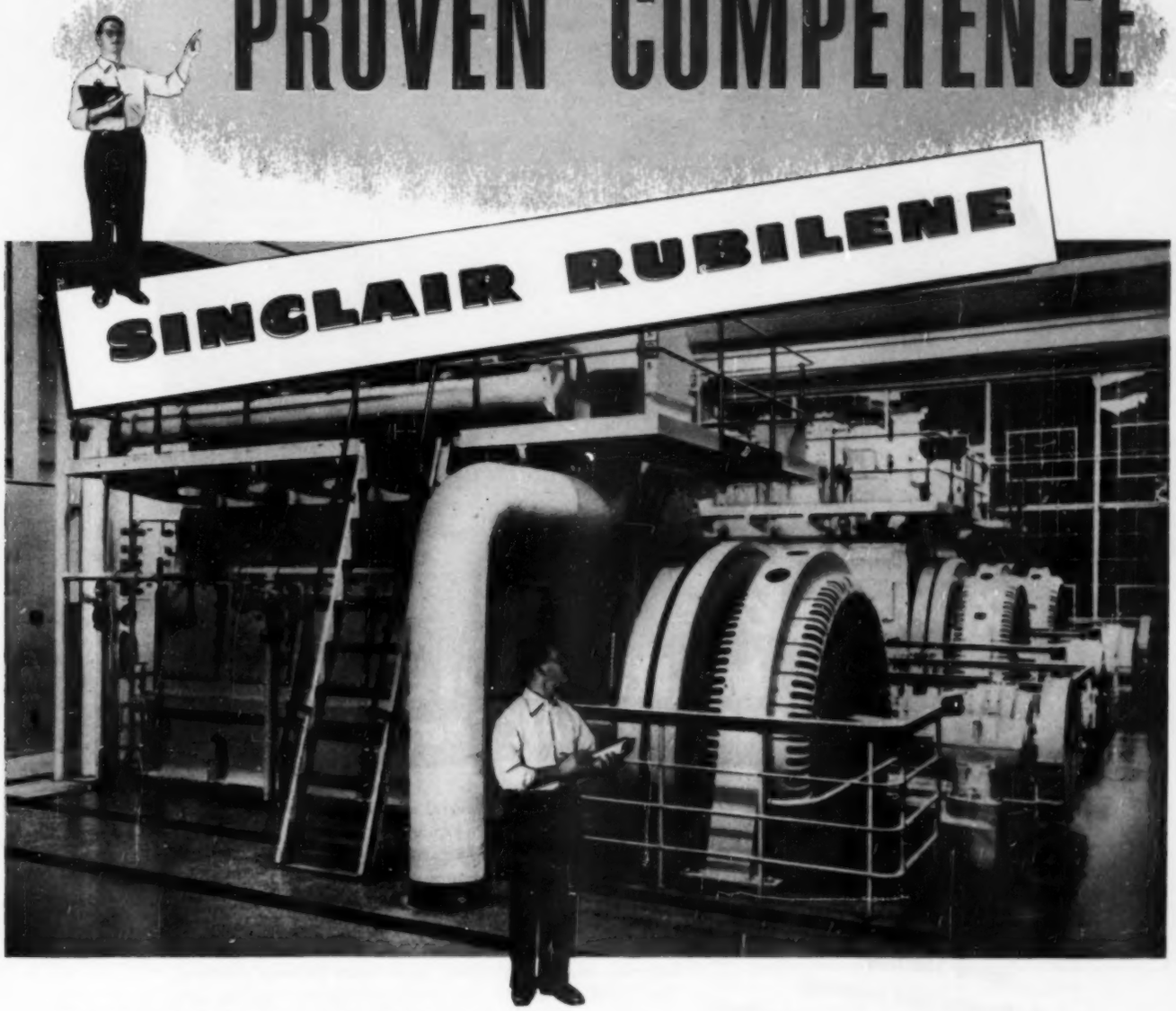
PISTON RINGS · PISTONS
CYLINDER SLEEVES

PROVEN COMPETENCE



Ever since the birth of the modern diesel, Sinclair RUBILENE has been first choice of engineers in installation after installation, large and small . . . and has the endorsement of many of the largest diesel manufacturers.

Keeping progress ever since with improvements in diesel design and changes in operating requirements, Sinclair RUBILENE has built up an enviable record of many thousands of hours of trouble-free, dependable performance.

Yes, RUBILENE'S competence has been proven by years of satisfactory service.

SINCLAIR INDUSTRIAL OILS

For lubrication counsel, see your nearest Supplier of Sinclair Products or write Sinclair Refining Company, 630 Fifth Avenue, New York 20, N. Y.

The Big 2505
BUDA MARINE DIESEL
They're Using Off All Coasts

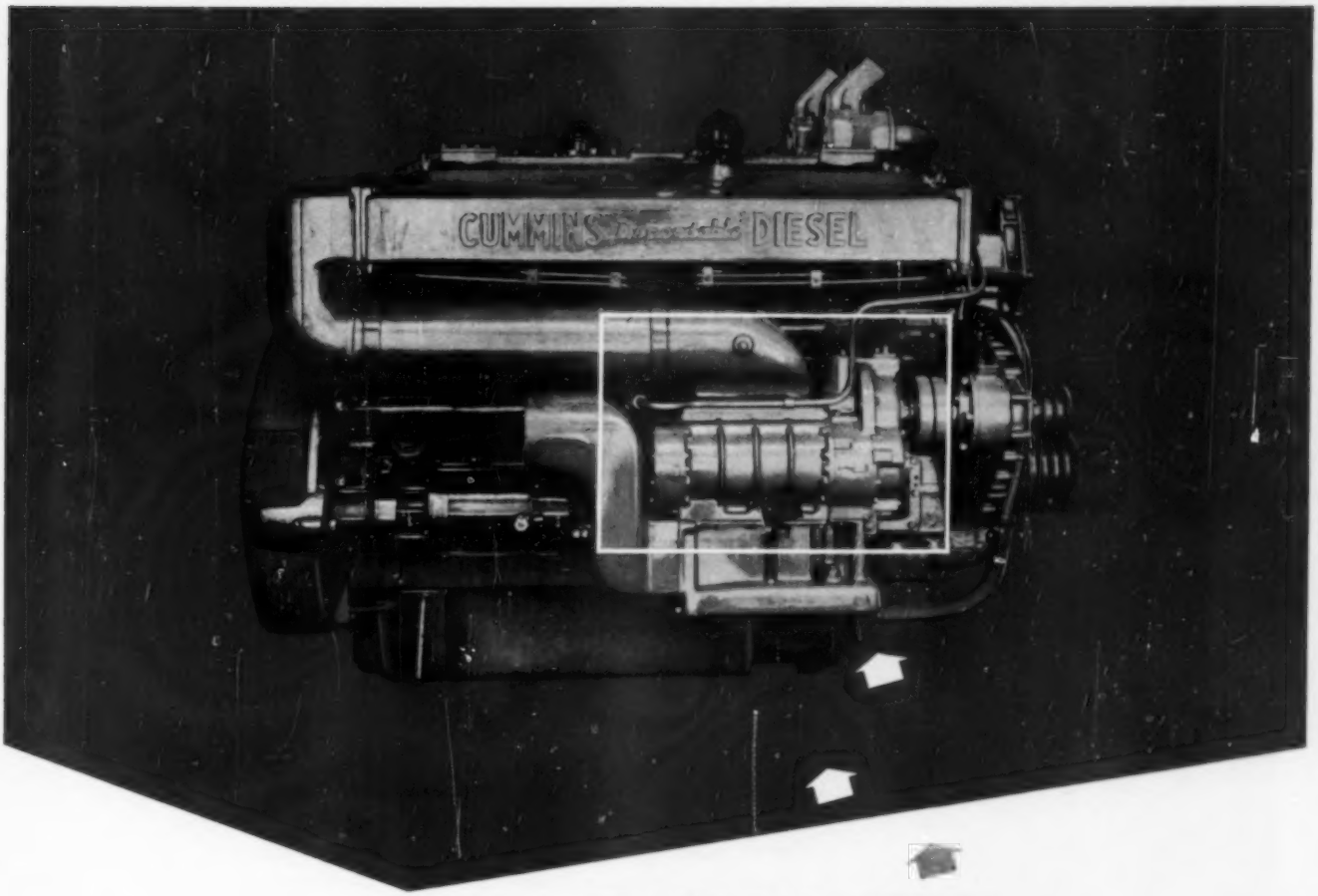
HERE'S WHY...

- **More power...greater displacement**
- **Smoother, quieter operation, easier starting**
- **Greater fuel economy**
- **More hours between overhaul**
- **Absolute reliability**

The Buda 2505 is a powerful 8 cylinder, heavy duty work horse that keeps delivering quiet, smooth, dependable power *longer* at *lower cost*. That's why more and more fish boat and tow boat owners and operators on all coasts are installing the "2505" in new boats and on re-powering jobs.

This is a BIG engine—developing its power through 2505 cu. inches of displacement—not speed of piston. That means less wear and tear on parts, more hours between overhaul. The "2505's" efficient slow combustion system cuts fuel costs . . . lower peak pressures provide smoother power, increased engine life and assure less maintenance. Get the full "2505" story from your nearby Buda Marine Distributor, or write today for complete information and Bulletins. The Buda Company, Harvey, Illinois.

BUDA — **A Power-Full and Dependable Name In Engines**



BUILT-IN POWER

Cummins Diesels now have BW Superchargers built-in for added horsepower and economy

Cummins Engine Company, Inc., of Columbus, Indiana, now builds-in BW Superchargers on their new high-speed diesel, model NVHS-1200. This new engine develops 550 h.p. at 2,100 r.p.m. and weighs only *8.3* lbs. per horsepower. The naturally aspirated version, NVH-1200, with the same bore, stroke and cubic inch displacement, as the supercharged engine develops 400 h.p. at 2,100 r.p.m. and weighs *10.8* lbs. per horsepower.

For motor truck, marine, railway or general industrial applications, supercharging means savings in engine space and weight . . . means *power* to pull heavy loads . . . means sea level operation at high altitudes. All these extra benefits without corresponding increases in operating costs.

The engine manufacturer who wants to pack more power into a given engine size . . . or who wants to add an entire new series of models to his line without re-tooling or the expense of redesign, can do so simply by equipping his present line with BW Superchargers. One of our engineers will gladly explain how this can be done. There is no obligation. Write today to

engineering Pesco production

PRODUCTS DIVISION

BORG-WARNER CORPORATION

24700 NORTH MILES ROAD BEDFORD, OHIO

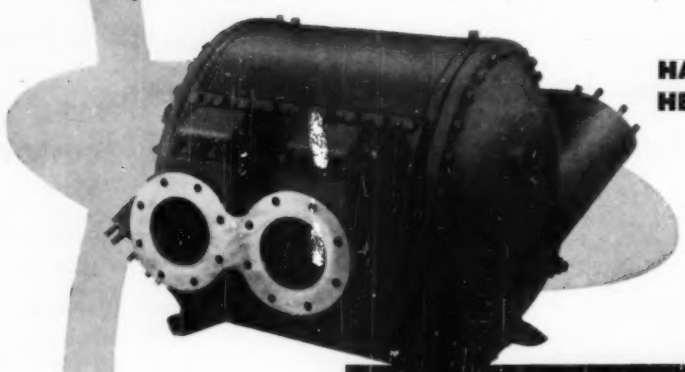
Hit-or-Miss Methods Are Out!

There's no compromise with quality at Harrison!

That's why over the years, leading manufacturers of Diesel equipment have looked to us for the answers to their heat transfer problems. They know that Harrison coolers are developed by the most experienced design and engineering staff in the field—built by the largest producers of cooling equipment in the country.

Yes, every job—large or small—is carefully engineered, thoroughly tested and then produced at lowest possible cost. A capable service organization safeguards customer satisfaction on every installation.

For full details, write or call us. We're always ready to take care of your heat transfer needs.

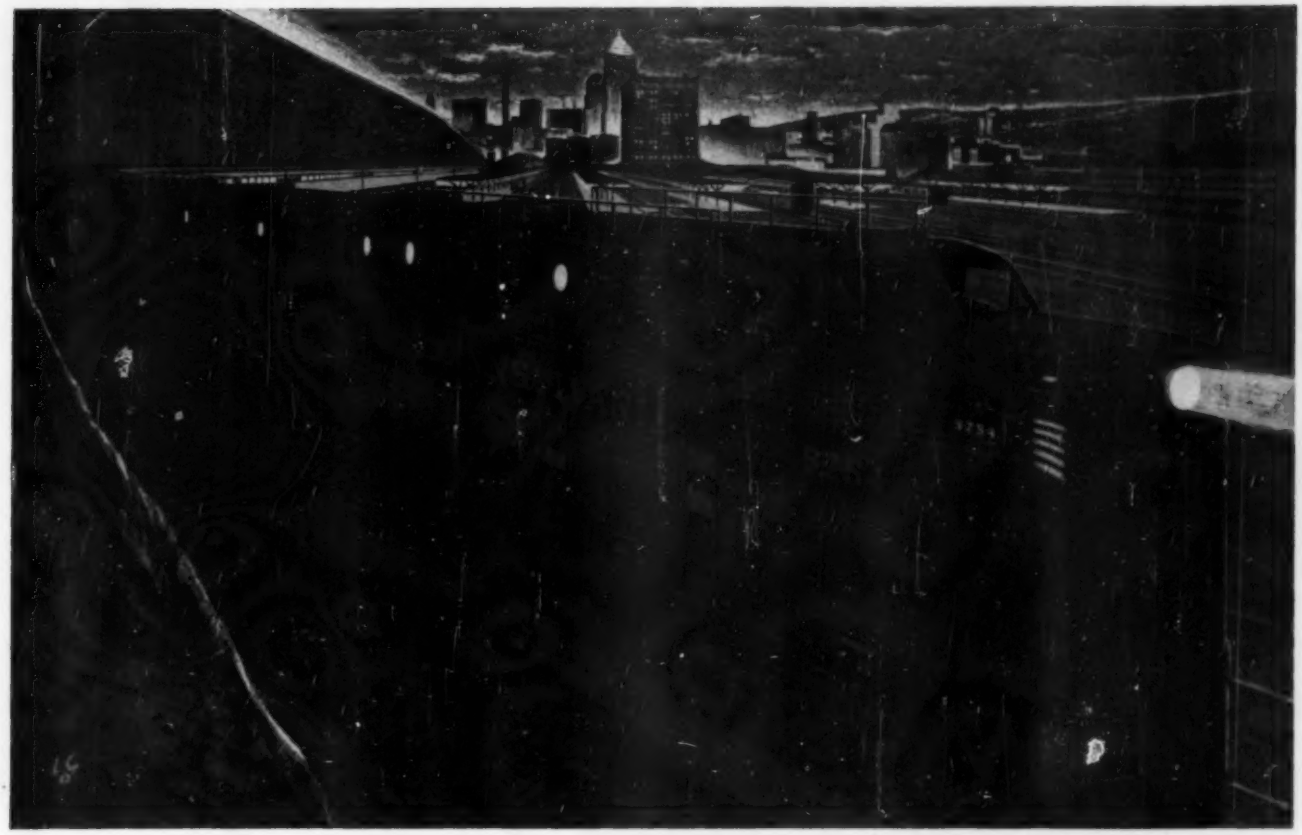


HARRISON
HEAT EXCHANGERS

HARRISON

HARRISON RADIATOR DIVISION,
GENERAL MOTORS CORPORATION, LOCKPORT, N. Y.

the trend is to Diesels — and to
GULF DIESELMOTIVE OIL



THE PITTSBURGHER, crack train of the Pennsylvania Railroad, leaving the Pennsylvania Station in Pittsburgh on its nightly run to New York City.

As recently as January 1949, there were only about 5,600 Diesel locomotives in service on U. S. railroads. Today the figure is over 10,000! And new Diesels are being placed in railway service just as quickly as the manufacturers can produce them.

More and more of these fast and powerful units get the right start for a long life and low maintenance costs with a crankcase fill of Gulf Dieselmotive Oil. Many of the Diesel locomotives for the crack trains of the Pennsylvania Railroad, for example, are lubricated with Gulf Dieselmotive. This outstanding oil keeps Diesel engines clean, prevents bearing corrosion, foaming, and excessive wear.

Gulf Dieselmotive Oil is one of a family of outstanding Diesel lubricating oils which includes Gulfpride-Diesel and Gulflube Motor Oil H.D. for automotive Diesel engines; Gulf Parvis Oil and Gulf Universal Oil for stationary and marine Diesel engines.

For further information on Gulf Diesel lubricating oils and for practical help on any Diesel lubrication or maintenance problem, call in a Gulf Lubrication Engineer.

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Located in principal cities and towns throughout Gulf's marketing territory

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Choose from the complete *Alnor* Line for the Thermocouple Performance You Need

For every diesel—from the largest Power Plant to the smallest auxiliary—there is an Alnor thermocouple specially designed to give consistently accurate service. These exceptionally rugged couples have proved in years of top performance that they can give precision operation under all conditions . . . in all applications. In fact they have been specified by every major engine manufacturer as original equipment.

Choose the type and style you need—in a wide price range. Take advantage of the Alnor design, which assures non-rust, waterproof, dustproof and corrosion-resistant performance. Send for information on the rigid types, featuring easily detachable stem and "no thread" conduit connections—an Alnor exclusive. Or if your thermocouple problem calls for a flexible, detachable style, ask about the flexible Alnor types with non-rusting cables that will not crack or break under the toughest handling. *SEND FOR BULLETIN.*

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Alnor

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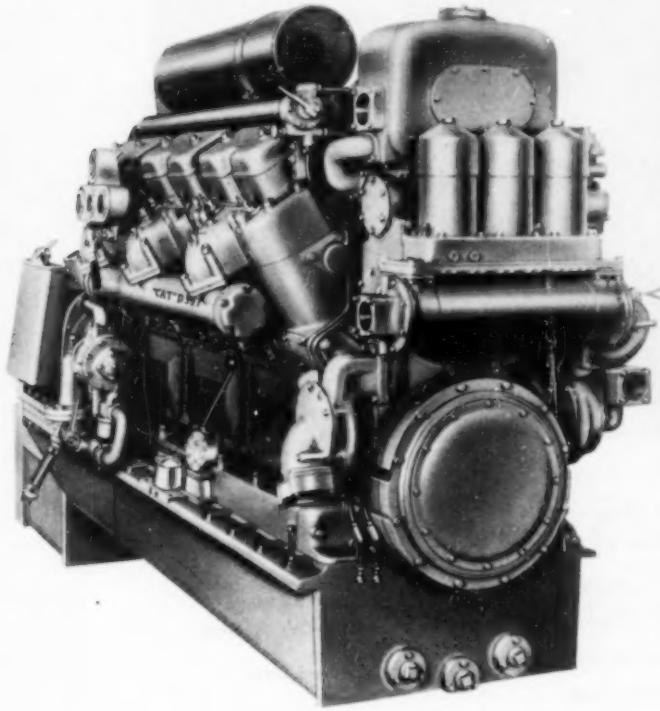
"Build-up never made a champion.
Real quality must be *built in,"*

says **CATERPILLAR**
REG. U. S. PAT. OFF.

therefore, extreme caution in selecting such vital components as heat exchangers



The reputation of "Caterpillar" Diesels comes from no one policy or practice, but from a number of things that are an integral part of every engine leaving the plant at Peoria, Illinois. "Caterpillar" sums it up in three words — *built in quality!*

To those having had no personal experience with "Caterpillar" Diesels, *quality* is probably too broad a term, but not so for "Caterpillar" users. To them, it's the combined result of meaningful research . . . sound design, engineering and construction . . . high standards in selecting materials and components.

Yes, standards for selecting such important components as heat exchangers *must* be high . . . because lube oil and jacket water cooling efficiency is so vital to the performance *and the reputation* of "Caterpillar" Diesels. Failure of an exchanger, or any other component, can well be a black mark against the whole engine.

And so it is, on the "Caterpillar" installations displayed here, and in countless other applications — oil drilling, mining, pipelines, sawmills, factories and farms, to name a few — you'll find the heat removal job entrusted to Ross Exchangers. For Ross has a quality reputation, too . . . the kind that "Caterpillar" and other leading Diesel builders require . . . the kind that matches their own.

• **DESIGN DATA IN ROSS LITERATURE** Whether the Diesels you build or buy have large or small H.P. ratings, Ross can furnish fully standardized units from stock. Complete literature mailed at your request.

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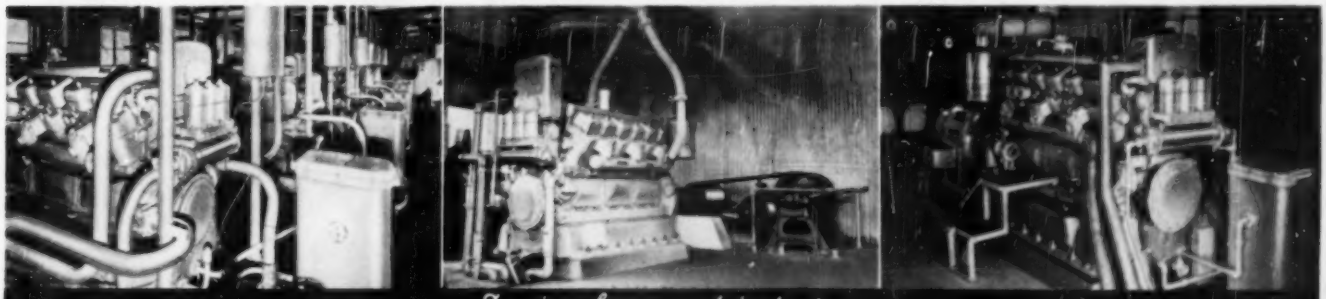
ROSS
Standardized
EXCHANGERS

Five "Caterpillar" Diesel Electric Sets generating power for floating cutter dredge operating in large project in Lagos, Nigeria, West Africa. All have both Ross lube oil and jacket water coolers.

One of two "Caterpillar" Diesels driving all machinery in cotton gin plant of Duncan Co-operative, Inverness, Miss. Ross lube oil coolers on both.

"Caterpillar" Diesel Electric Set, equipped with Ross lube oil cooler. Mountain Utilities Corp.'s standby power plant for city of Aspen, Colorado. Also powers world's largest ski lift.



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Cut-a-way view of a Walseal Tee showing ring of silver brazed alloy, and completed Silbraz joint.

Specify Walseal* Products

On all types of piping jobs where Type "B" copper or red brass pipe is used, trouble can be avoided by installing Silbraz* joints — made with Walseal valves, fittings and flanges.

Threadless, patented Silbraz joints are silver brazed (not soft soldered) pipe joints that are leakproof, trouble-free — permanent . . . connections that will not creep or pull apart; that literally join with the piping system to form a "one-piece pipe line". Thus, these modern joints eliminate the need for maintenance and costly repairs — especially important where lowered operating costs are imperative.

For complete details on the modern Silbraz joint, made with Walseal products, write for a copy of Walworth Circular 84.

**Patented — Reg. U. S. Patent Office.*

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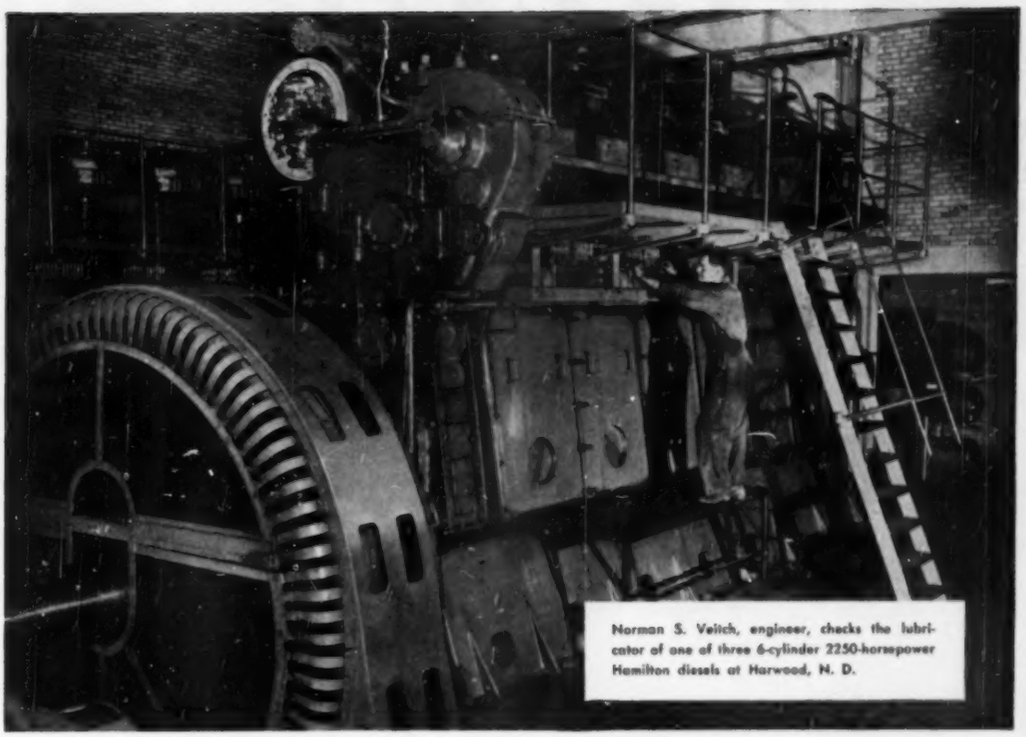

Norman S. Veitch, engineer, checks the lubricator of one of three 6-cylinder 2250-horsepower Hamilton diesels at Harwood, N. D.

HAMILTON DIESELS

" . . . about as perfect a machine as we could get"

says the Chief Operator of this plant

This is the Harwood, North Dakota, plant of the Minnkota Power Cooperative. Since early 1947, three Hamilton diesels, each rated 2250 hp at 240 rpm, have been supplying 1,200,000 to 1,500,000 kwh per month to about 30,000 customers.

Mr. Helmer N. Eraker, Chief Operator since the plant began functioning, says "Considering everything, we have had a minimum of trouble. Under the job it is called upon to do, it is doing well—about as perfect a machine as we could get."

* * *

Hamilton diesels, with 21½ inch bore and 27½ inch stroke, are available with 5 to 12 cylinders. Ratings are 482½ bhp (net) per cylinder as a straight diesel and 455 bhp per cylinder as a dual fuel engine, both at 257 rpm. For full information, call the Lima-Hamilton Sales Offices in New York or Chicago, representatives in other cities, or write directly to Lima-Hamilton Corporation, Hamilton, Ohio.

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HOOVEN, OWENS, RENTSCHLER CO. **HAMILTON, OHIO**

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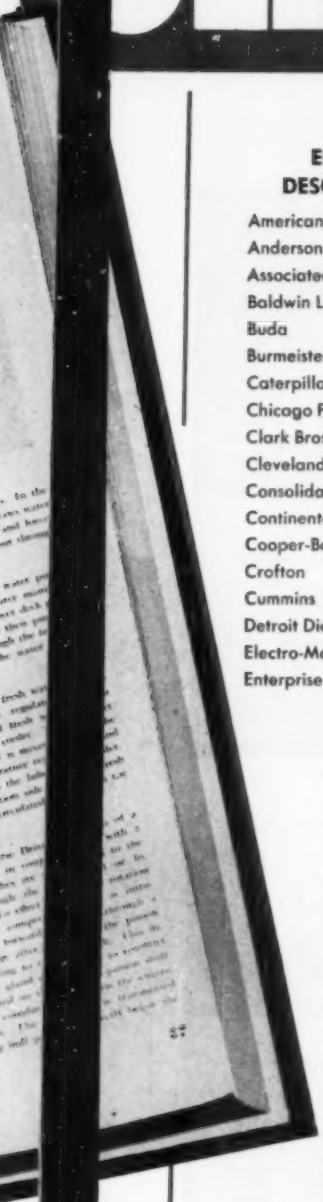

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Associated British Oil Engines
Baldwin Locomotive Works
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Caterpillar
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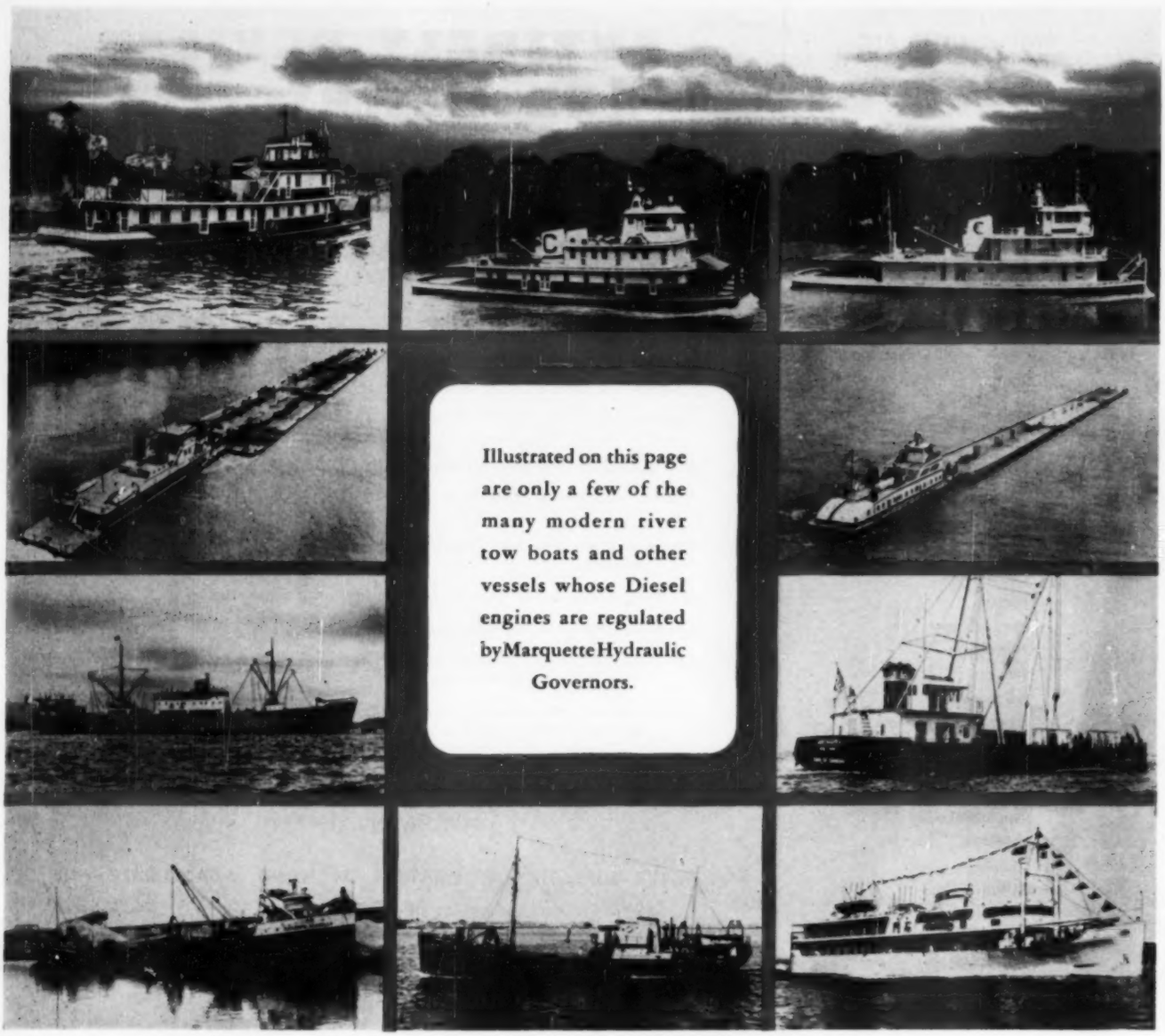

Illustrated on this page are only a few of the many modern river tow boats and other vessels whose Diesel engines are regulated by Marquette Hydraulic Governors.

The Marquette METAL PRODUCTS CO.
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A SUBSIDIARY OF CURTISS-WRIGHT CORPORATION

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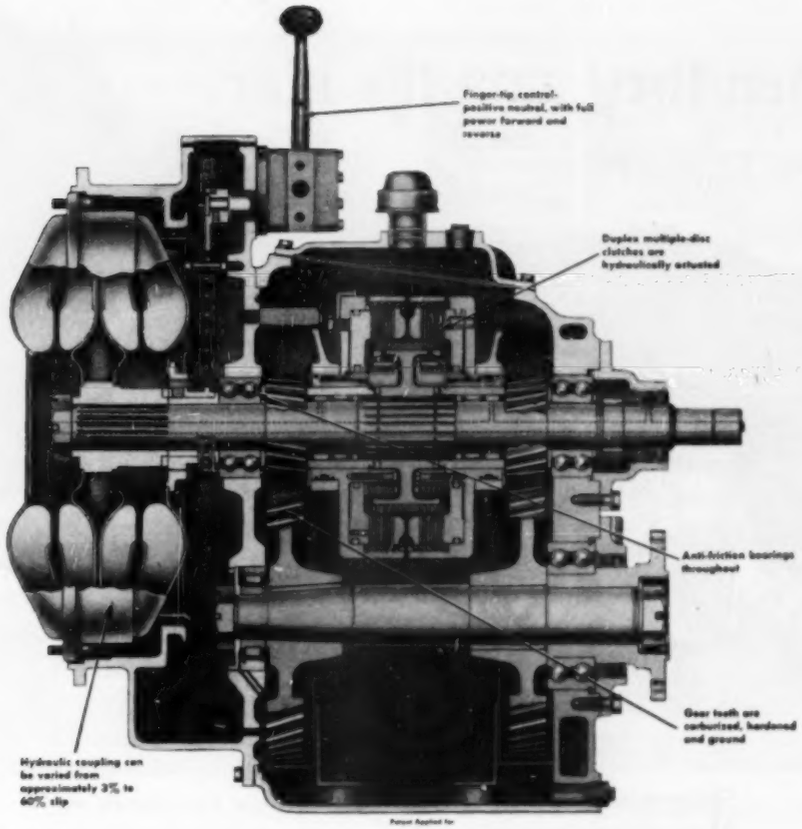

Finger-tip control—positive neutral, with full power forward and reverse
Duplex multiple-disc clutches are hydraulically actuated
Anti-friction bearings throughout
Gear teeth are carburized, hardened and ground
Hydraulic coupling can be varied from approximately 3% to 60% slip

Now Hydraulic Drives for Marine Diesels

The TWIN DISC MGH-220

Fouled-up engines and run-down batteries from hours of trolling are only two of the costly, and dangerous, aggravations which can be eliminated with the new Twin Disc MGH-220 Hydraulic Marine Reverse and Reduction Gear.

The hydraulic coupling between the engine and the gearing in this unit is a *variable-fill* coupling which can be adjusted to permit up to 60% slip by the touch of a valve. The practical effect of this slip is to multiply the normal reduction ratio by 2½; with 3:1 gearing, for example, it gives the equivalent of a 7.5 overall reduction.

Engine rpm can be kept in an efficient range while propeller shaft speed is properly slowed for trolling . . . yet at the touch of a valve normal reduction can be restored for "first out, first back" performance.

In addition, the hydraulic feature produces the smoothest power transmission of all, dampens out engine vibrations, protects the engine and gears against sudden shocks when the propeller is fouled.

For trolling without trouble, plus many other new advantages not described here, write today for complete information on the new Twin Disc MGH-220, which is adaptable to engines from 135 to 230 hp in the 1400 to 2100 rpm class. The MGH-220 is also available as a marine reverse and reduction gear with a rubber block drive instead of the hydraulic coupling.

Clutches & Hydraulic Drives

TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin • HYDRAULIC DIVISION, Rockford, Illinois

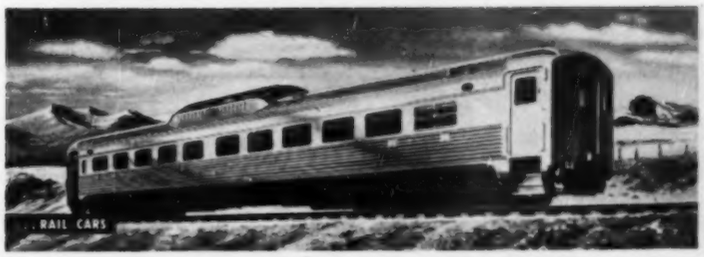
BRANCHES: CLEVELAND • DALLAS • DETROIT • LOS ANGELES • NEWARK • NEW ORLEANS • SEATTLE • TULSA

"When they saw the star, they rejoiced---"

Matthew 2-10

IS not this, then, a season for rejoicing . . . a season for reviewing and re-appraising the priceless values we have enjoyed in this America? Among others, the eminent right of free enterprise . . . the right to work at or leave any job anywhere at any time. Shall we not agree that so fortunate a people must guard its heritage jealously? This land of ours challenges men against failure in any venture . . . its reward to men who work is a certain security . . . a certain freedom to think and to act together and as individuals for the greatest good to all the people of the world. Shall we look with sincere appreciation upon the gift we have so lately received from the valiant? . . . Shall we pause this Holiday Season to render to God our gratitude and to America our undivided loyalty so that there may be. . .

Peace on Earth to Men of Good Will.



This is the Diesel

that speeds the big jobs

HERE IT IS—the newest member of the General Motors Diesel family—the brawny 6-110 engine that develops 275 horsepower.

It is 50% more powerful than the famous 6-cylinder GM "71" engine that powers so many trucks, buses, boats, construction equipment and other mobile, portable and stationary units.

This rugged new Diesel doesn't care what's tied to its tail. It has power to spare to keep big jobs humming, yet is so compact it doesn't hog space.

For example, each new Budd RDC rail car is driven by a pair of 6-110 Diesels with GM torque converter transmissions. The compactness of these power plants permits mounting them under the floor so that no revenue space is lost. These rail cars accelerate from standstill to 44 miles per hour in just one minute and have a top speed of 83 mph with a full load.

Like all other GM Diesel engines the 6-110 is two-cycle—delivers power on every piston downstroke. This advanced design cuts down Diesel size without sacrificing ruggedness; it insures fuel economy, lower maintenance costs, exceptional dependability and long life.

The GM 6-110 engine provides Diesel power at its best for heavy-duty jobs—not only for rail cars but in the largest mountain-type trucks, huge rock crushers, deep-sea fishing and pleasure boats, big pumps and compressors, mining and oil field equipment. *It is an exceptionally compact Diesel for its horsepower—an engine that gives remarkably fine performance in minimum space.*

DETROIT DIESEL ENGINE DIVISION

SINGLE ENGINES . . . Up TO 275 H. P. **DETROIT 28, MICHIGAN** MULTIPLE UNITS . . . Up TO 800 H. P.

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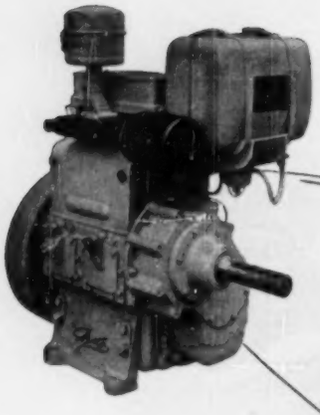
GM GENERAL MOTORS DIESEL POWER

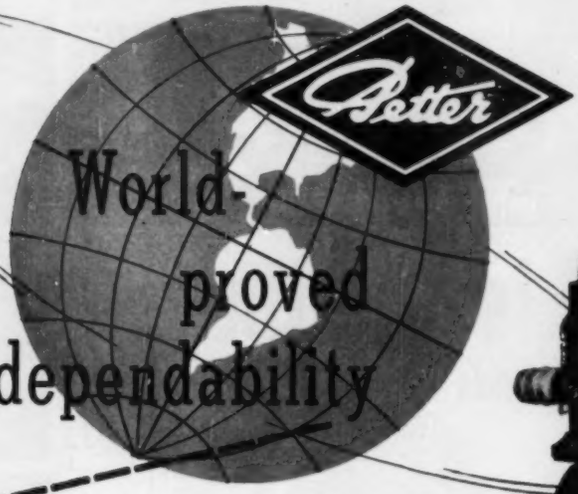
Only GM Diesels provide all these advantages

Compact size—less weight per horsepower . Two-cycle smoothness, power on every downstroke . Quick starting, on its own fuel . Unit injectors—no high-pressure fuel lines . Rapid acceleration . Cleaner burning . Better high-altitude performance . Easy accessibility.

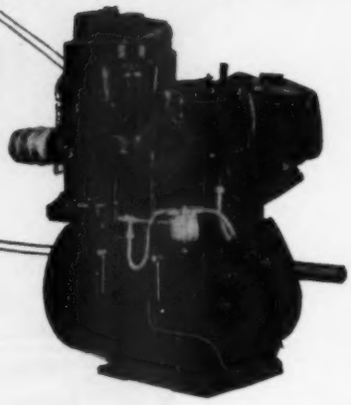
"Your Key to Power Economy"



PETTER MODEL B: *2, 3 and 4 cylinders giving 18, 27 and 36 hp at 1500 rpm. Instantaneous cold starting; runs smoothly, dependably.*



PETTER MODEL AV: *1 and 2 cylinders giving 5 and 10 hp at 1500 rpm. Starts quickly, easily; rugged, dependable.*



at down-to-earth prices

...that's why

Petter is Preferred!

(Diesel Engines from 5 hp to 36 hp)

When you buy Petter Diesels, you benefit from low initial cost, utmost operating economy, and dependable performance proved in 83 countries. Compare them with others and you will find they are *30% to 40% lower in cost*—a substantial saving for you. Compared with the expense of running gasoline engines, you will find Petter Diesels actually run at ¼ *the cost.*

Another reason why Petter Diesels are preferred is because these ruggedly-built, direct injection, 4-cycle engines give long, efficient service with an absolute minimum of maintenance. *Drive can be taken off either side at engine speed, or off timing-gear side at half speed.*

Petter Diesels are ideal for Generators, Compressor Drives, Pumping Units, Road Rollers, Tractors, Stone Crushers, Concrete Mixers, Saw Benches, Refrigeration Machinery and virtually every application where a dependable source of economical power is needed. Petter Diesels available in sizes from 5 hp to 36 hp. Other ABOE, Inc. diesels up to 3,000 hp.

Throughout the world, even in such far-off and remote locations as Seychelles, Yukon, Patagonia or Fiji, to mention only a few, Petter Engines, parts and service are available. This is an added advantage for you if your equipment is to be sent outside the United States. Wherever it goes on the face of this earth, it will not be far removed from a Petter distributor. Backed by a production capacity of up to 1500 Petter Diesels weekly, Aboe, Inc. maintains in America a continuous supply and minimum prices through its nationwide network of competent and responsible Petter distributors.

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CONTENTS FOR DECEMBER, 1950

Three New Diesel Ships 33
Union Pacific Again Sets Pace 36
Harlan, Iowa 38
Diesel Tractor Conquers Mountain-Goat Slopes 40
Diesel Driven *Good Neighbor* 42
Diesel-Steam-Hydro Power System 44
Some Typical Diesel Applications 48
Shale Oil for Diesels 50
Valve Problems in Diesel Engines 56
New Elliott Turbocharger 60
What's Going On in England 62
Diesel Ship *L. L. Wright* 64
Supervising and Operating Engineers Section 66
The Gas Turbine? — Not Yet 67
High-Speed Diesels . . . . . Design, Operation and Maintenance . 68
Exchange Your Diesel Maintenance Ideas 70

DIESEL PROGRESS for December, 1950, Vol. XVI, No. 12. Published monthly by Diesel Engines, Inc., 816 N. La Cienega Blvd., Los Angeles 46, California. Tel. BRadshaw 2-6273. Subscription rates are $5.00 for U.S.A. and possessions. All other countries $7.50 per year. Subscriptions may be paid the London office at 22-12s-6d per year.

DIESEL PROGRESS is indexed regularly by Engineering Index, Inc.

EDITORIAL AND PRODUCTION OFFICES

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knows it's "horse sense" to standardize on

FULTON DIESELS

Since 1929, the Harlan, Iowa, municipal plant has installed six diesels totalling 8,385 h. p. — 100% FULTON.

The newest, a 2,760 h. p. 6-cylinder Type KSS, shown in the foreground above, went into service just a year ago. Already it has set a remarkable record of fuel economy: 14.01 K. W. at loads varying from 57 to 70 % of capacity.

Two decades of troublefree performance — rock-bottom operating and maintenance costs — have *earned* Harlan's faith in FULTON. Consider *total cost per year of service*, not first cost alone. You'll see why it's just good "horse sense" to choose thoroughbred

FULTON DIESELS — YOUR BEST BUY IN THE LONG RUN

FULTON IRON WORKS COMPANY
SAINT LOUIS 14, MISSOURI
NEW YORK OFFICE: 82 WALL STREET, NEW YORK 5

THREE NEW DIESEL SHIPS

By: Dwight P. Robison

Argentine Naval Commission cargo ship *Bahia-Aguirre* powered with two Nordberg 1,875 shp. diesel engines.

THE decision of the Argentine Government to embark on a program of opening up Southern Argentina has resulted in the building of three cargo passenger vessels, the *Bahia Aguirre*, *Bahia Buen Suceso* and *Bahia Thetis*, all of which have been commissioned and are now in service. These ships of 3,100 ton deadweight are capable of carrying 40 first and 60 tourist class passengers and 800 immigrants or military personnel when required. Propelling machinery for each of these ships consists of a pair of 2-cycle, 5-cylinder, direct reversing, 1,875-bhp. Nordberg marine diesel engines. These ships, designed by Milne, Gilmore & German, Montreal, and built by Halifax Shipyards Limited, Halifax, N. S., have been constructed and equipped in accordance with the requirements of Lloyd's Register of Shipping for the classification +100A-1, and Canadian steamship inspection requirements for International Regulations for safety of life at sea. Throughout the construction of these vessels, the owner's representatives, the Argentine Naval Inspection Commission, with Commander Engineer Italo Luciani in command, were in attendance at Halifax. They are to be highly commended for the efficient and friendly manner in which they have carried out their duties.

Table I

Leading Particulars

Length overall	336 ft., 0 in.
Length B. P.	312 ft., 0 in.
Breadth moulded	47 ft., 0 in.
Depth moulded to upper deck	26 ft., 0 in.
Gross tonnage	3,828
Net tonnage	2,119
Deadweight, tons	3,100
Displacement, tons	5,225
Load draft, summer freeboard	18 ft., 6 in.
Block coefficient (loaded draft)	0.674
Water-plane coefficient (loaded draft)	0.808
Cargo capacity (grain) cu. ft.	171,757
Fuel oil, tons	451
Fresh water, tons	111
Water ballast (tons)	224
Speed in service knots	15
B. H. P.	3,750
R. P. M.	225

The design of the *Bahia Aguirre* and her sister ships is identical. The vessel is of the long bridge superstructure design. The lower deck extends right fore and aft. Erections above the upper deck comprise a forward mast house, bridge superstructure incorporating promenade, boat and bridge decks. Two masts and a well proportioned funnel of elliptical section, all appropriately raked, add to the appearance of the ship. Subdivision is effected by five main transverse, watertight bulkheads extending to the upper deck, with an additional transverse bulkhead up to 3 ft. 0 in. below lower deck forming the aft boundary of the midship fuel oil deep tanks. The arrangement provides for three holds, two forward of the machinery space and one aft. In No. 3 hold the shaft tunnels and non-potable fresh water tanks have been combined to form one structure through the center of the hold with cargo stowage space on either side of the tunnels.

First class passenger accommodation is provided on the promenade deck. Third class accommodation is contained on the after part of the promenade deck and the upper deck. Officer quarters are confined to the boat deck, where separate hospital accommodation for men and women has also been arranged. A generously sized and well appointed captain's suite occupies the aft end of the navigating deck house. Warrant officers and petty officers are accommodated forward and aft of the third class cabins, while crew accommodation is confined to the lower deck aft. Portable accommodation for troops or immigrants is provided in Nos. 1, 2 and 3 tween decks.

Propulsion power for the *Bahia Aguirre* as well as for the *Bahia Buen Suceso* and *Bahia Thetis* is supplied by two Nordberg 2-cycle, 5-cylinder, direct reversing diesel engines of 21½-inch bore and 29-inch stroke. These Nordberg Type TSM-215 marine diesel engines are of the trunk piston, mechanical injection type and at 225 rpm. develop a continuous total rating of 3,750 bhp. Each engine has a built-in reciprocating scavenging pump driven directly from the crankshaft. Fresh water cooling of the cylinder jackets and heads is provided and the pistons are cooled by lubricating oil. The pumps for circulating jacket water, salt water and lubricating oil are independently motor driven. Heat exchangers of the shell-and-tube type are used for cooling the lubricating oil and jacket water with sea water, which passes through the tubes. Each engine is provided with a thrust bearing. Starting air at a pressure of 300 psi. is stored in each of two receivers. There

are two diesel driven starting air compressors of 28 cfm. capacity capable of compressing the air to 390 psi. The air passes through a reducing valve to a surge tank at a pressure of 250 psi., at which pressure it is delivered to the engines. A special gaugeboard was designed by Nordberg to accommodate the numerous pressure gauges, tachometer indicators, signals to indicate whether or not the turning gears are engaged, clock and pyrometer indicator for each cylinder of the main engine.

The demand for electric power is supplied by two Fairbanks-Morse diesel generators, 192 kw., 220 vdc., and one 106 kw. 220 vdc. In addition a Fairbanks-Morse drip proof marine type, 20 kw. 230 vdc. emergency generator is fitted in the engine casings at the boat deck level. Steam requirements are fulfilled by a Foster Wheeler "D" type oil fired boiler, steam rate 3,835 lbs. per hour, working pressure 50 lbs. psi.; and by a Foster Wheeler waste heat boiler, steam rate 1,540 lbs. per hour, working pressure 50 lbs. psi.

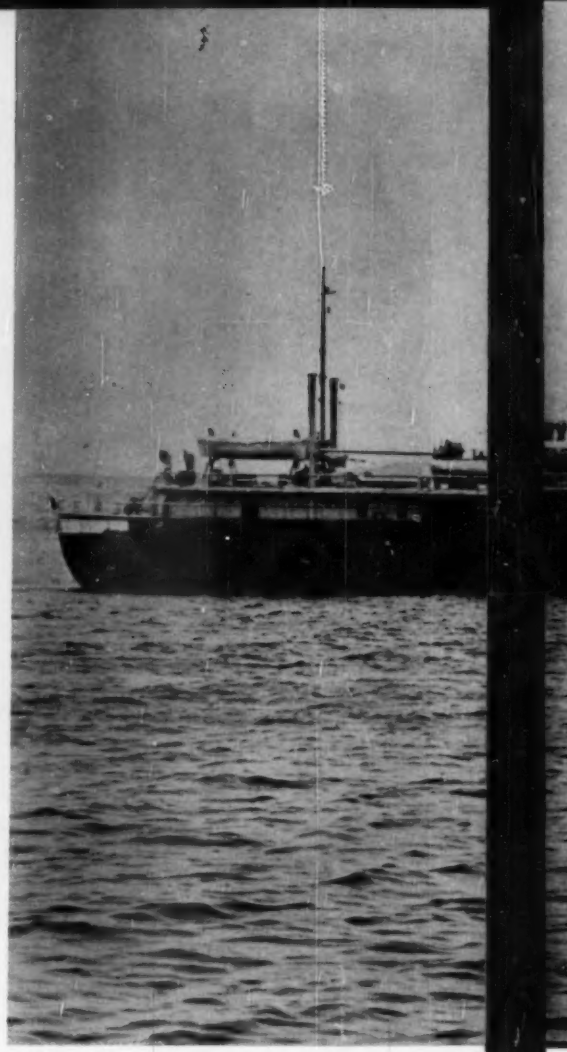
The engineer's workshop is well equipped and is fitted with a 12-speed, timkenized, geared head engine lathe, a pedestal tool and general purpose grinder, a floor type drilling machine, work benches, etc., and a comprehensive supply of hand tools.

To enable these vessels to be independent of harbor facilities while frequently operating in undeveloped harbors, they are fitted to carry three cargo barges of 30, 20 and 15 ton deadweight capacity. These barges are stowed on portable steel structures over Nos. 1 and 2 hatches and are launched by means of the ship's gear. Two motor launches are provided for towing purposes. The steering gear, installed aft on the lower deck, is of electro-hydraulic type on the Hele-Shaw Martineau principle manufactured by John Hastie & Company, Limited. Normally one pump, driven by an electric motor of 12 bhp., is in operation. However, both pump units can be used simultaneously to give rudder action from hard-over to hard-over in 15 seconds. The gear is arranged to hold the rudder central when the steering gear is not in use and also to act as a rudder brake. The controlling gear is a telemotor installation, normally operated from the wheelhouse, while a mechanical standard is provided on the promenade deck aft. In addition, the gear may be controlled by telemotor from the steering gear compartment.

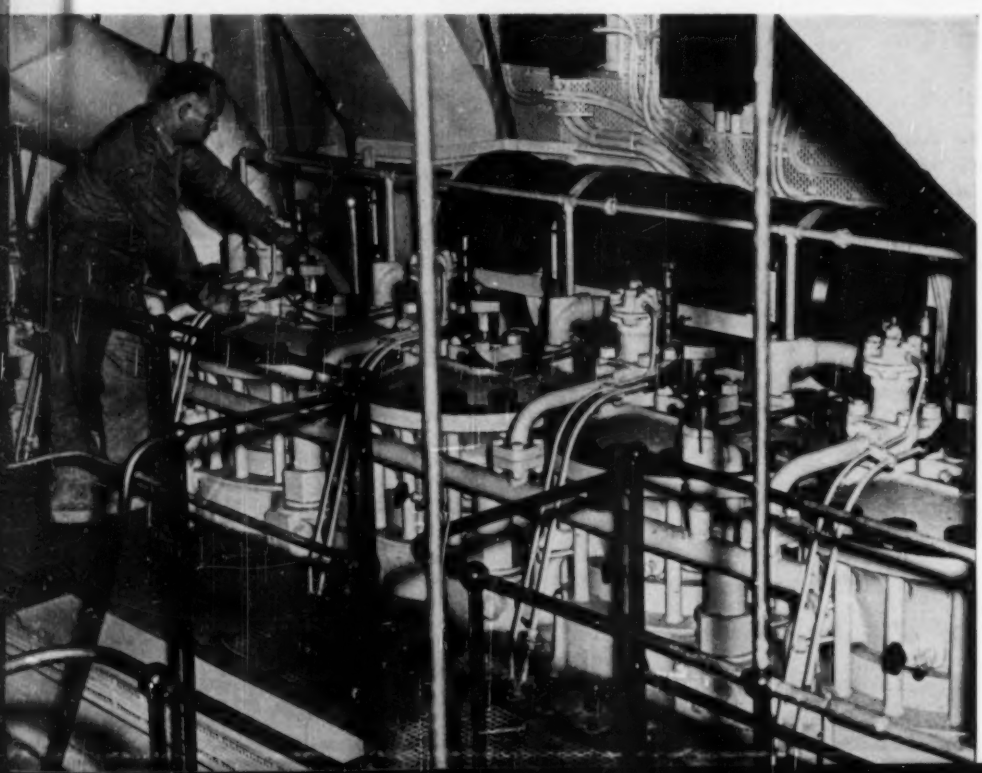
The towing launches, built by Canots Cadorette Canoes, St. Jean des Piles, and supplied through Triumph Continental Products, Montreal, although primarily carried for towing operations, are 27 ft. 0 in. in length and powered with 6-cylinder Kermath diesel engines, capable of developing 84 hp. at 2,600 rpm. and providing a speed of 12 knots running free. These launches have been ruggedly constructed in order to withstand frequent beaching, hoisting and lowering.

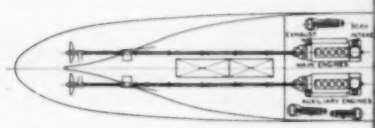
Fitted with an elaborate outfit of navigating appliances, the magnetic compass requirements of the *Bahia Aguirre* are fulfilled by a Hughes "Deadbeat" steering compass with patent non-resonant suspension binnacle. This is augmented by a Sperry Mark XIV Gyro compass, the master gyro being positioned on the upperdeck, starboard side, with gyro repeaters in the wheelhouse, on the bridge wings and on the wheel house top. As is now general practice in first class vessels, radar equipment has been provided. The installation is of the Mariners Pathfinder type with the view screen and transmitter located in the wheel house.

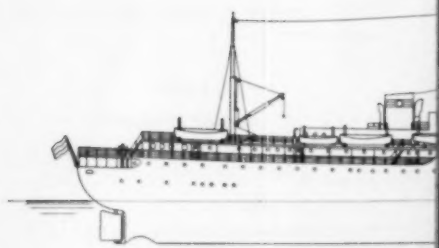
Other navigating aids include an indicating and recording fathometer; a draft indicator positioned in the wheel house; improved Graham type clinometer with sensitive reading of heel up to 50 degree angle; Mackay radio direction finder; marine barograph and thermograph; and Robinson's engine room telegraphs and revolution telegraphs. A Kent clear-view screen is fitted in the wheel house front. Besides the usual hand and electrical logs a Sal log has been installed. This is a recently new pressure-type log and operated by dynamic pressure developed in the opening of a pitot tube when the ship is moving forward. The

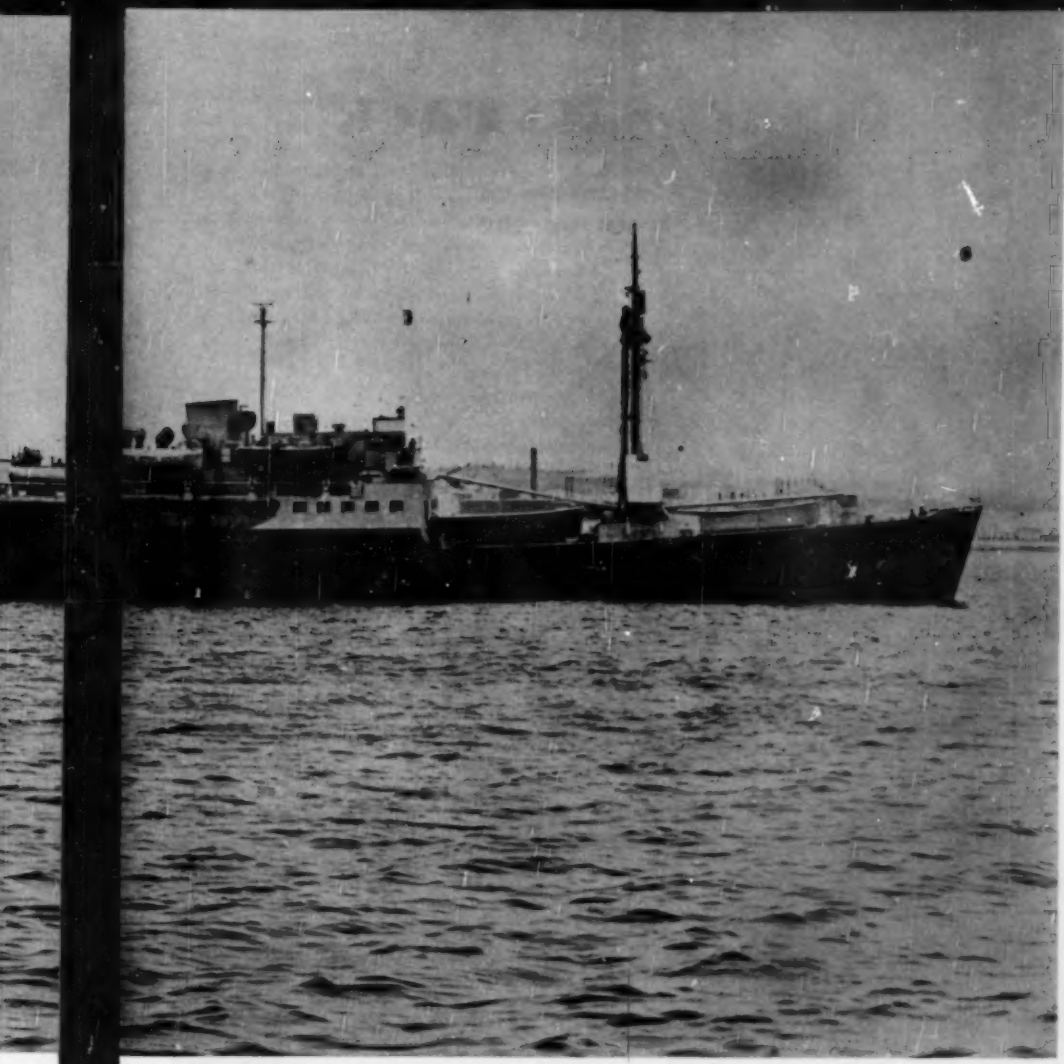


Engine room view along first platform on one of the two Nordberg diesels installed in the *Bahai-Aguirre*.









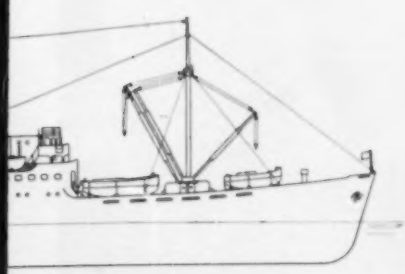
Two transmitters and two receivers are provided and in addition an emergency transmitter and receiver are installed. An auto-alarm system has been fitted to permit the highest efficiency and safety in communications. Operating in conjunction with the wireless equipment is a public address system equipped with recording facilities and loud speaker circuits, to all quarters of the ship. This system provides a convenient means for handling ship's orders. Ship intercommunication is served by Lyrngaphones in the wheel house, engine room, and forward and aft cargo handling positions, and by conventional sound-powered phones positioned throughout the ship.

Throughout the building of these vessels, every effort on the part of the designers, builders and owners has been made to insure the construction of a product of which Canada, the Canadian shipbuilding industry and the Argentine Navy may well be proud. These good-looking elaborately equipped and well finished vessels are excellent proof of Canada's shipbuilding ability and should contribute to substantiate Canada's position in the world shipbuilding field.

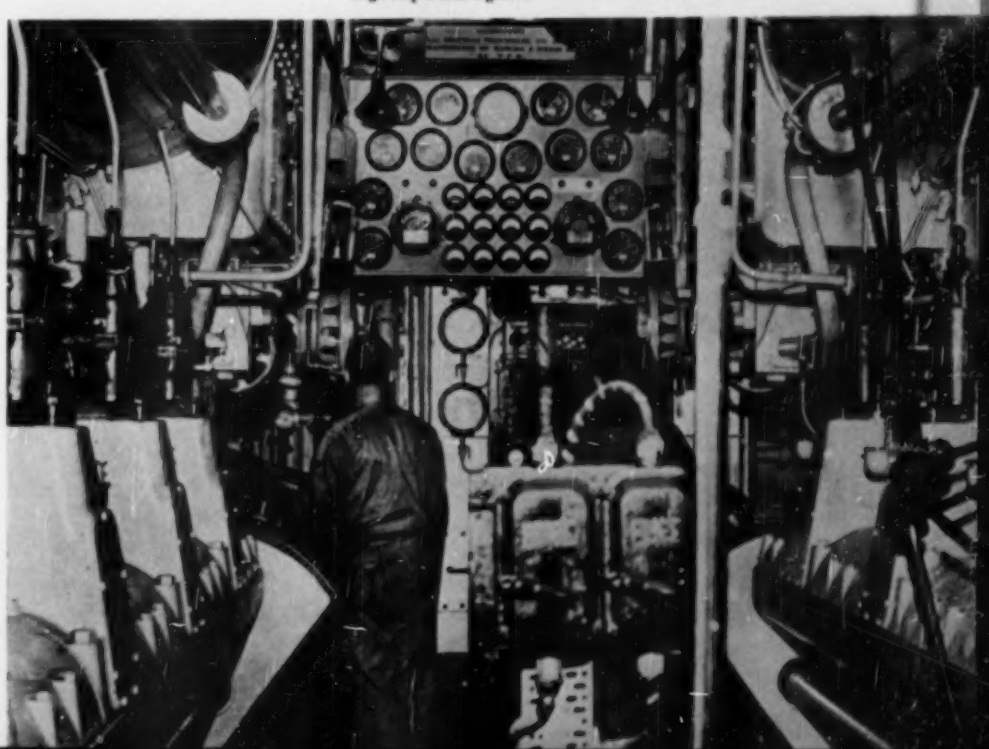
List of Equipment

Main Engines—Two type Nordberg diesel engines.
Generators—Two diesel driven, 8-cyl., Fairbanks-Morse generators; one diesel driven 6-cyl. Fairbanks-Morse generator; one diesel driven 3-cyl., 4½x5-in., 220 V.D.C., 20-kw., 31-hp., 1,450-rpm. Fairbanks-Morse generator.
Boilers—Waste heat, Foster Wheeler.
Boilers—Oil fired, Foster Wheeler.
Lub Oil Purifiers—One 360 USG/hr. at 150°F., De Laval; one 540 USG/hr. at 150°F., De Laval.
Lube Oil Coolers—Cooley "Thermaxchangers."
Heat Exchangers—Cooley "Thermaxchangers."
Generator Heat Exchangers—Ross Heater & Mfg.
Generator Lube Oil Coolers—Ross Heater & Mfg.
Air Intake Silencers—Maxim Silencer Co.

indicator, providing speed and recorded mileage, is positioned in the chart room. This equipment, manufactured by Svenska Ackumulator Aktiebolaget Jungner, Stockholm, has been supplied through Nife Incorporated, New York. Wireless communication is accomplished by a combined Marconi, MacKay radio transmitter and receiving outfit.



Engine room view showing part of the two Nordberg diesels and control panel on the cargo ship *Bahai-Aguirre*.



UNION PACIFIC AGAIN SETS PACE

G.M.'s "Train of Tomorrow" Finally Settles Down as the Crack 15-Car Diesel Supertrain on the Seattle-Tacoma-Portland Run

By CHAS. F. A. MANN

MOST discussed stretch of railroad track west of Chicago is the 190-mile double and triple track Seattle-Tacoma-Portland line of the Northern Pacific Railway. And beyond a doubt the most expensive and scenic bottleneck railroad line in the west. For years, because it traverses one of the most well-wetted areas on the continent, it has been a repository of coal and oil fired steam locomotives of the intermediate sizes that can run fast with fairly big tonnage on the modest grades and easy curves. But the most spectacular feature is a sort of railroad motive power and operating constipation caused by the fact that three of America's great railroad systems share a triple-joint trackage agreement for operations. A fourth, the N.P.-G.N. owned Seattle, Portland and Spokane Railroad, operates from Portland to Vancouver, Washington, also. So, all through the years of the birth of diesel on railroads, the progressive union Pacific has been needling the astute Great Northern and old lady Northern Pacific has been sitting blissfully by collecting rents and wheelage and all three railroads have been playing hoss in seeing how long each could outfox the other and keep its old junky passenger equipment and assorted castoff, middle size steamers shooshing up and down, while the public stayed away in droves and tried everything from midget autos, airplanes, buses and helicopters to get between the Capital of Puget Sound and the Capital of the Columbia River in something less than five jerky hours! Last spring Mr. Arthur Stoddard, new Union Pacific president, declared that the public had suffered long enough, and even if free soft boiler water from filling stations every mile was plenti-

ful, Union Pacific was going to put the most spectacular string of passenger cars ever built on the Seattle-Tacoma-Portland run and finally abandon steam power on its share of the "cesspool" pool train service (cesspool is only the milder of many adverse terms used in the northwest to slow down passenger service to the pace of the most indifferent of the three participating lines!). Meanwhile, on odd days, the G. N. and N. P. had arranged its transcontinental motive power turnarounds so as to put diesels on its trains a good share of the time.

Finally, when the U. P. quietly bought the G. M. "Train of Tomorrow" after it had toured the continent and made millions of potential customers goggle-eyed, for a neat cash figure of around $400,000, last spring, speculation raced over the nation as to where the train would go. Resplendent in armor yellow and maroon, these four cars swiftly became diluted into a full, splendid 15-car diesel streamliner, with a hot new sleeper off the *City of Portland* fresh from Chicago every morning, to carry the streamliner service north from Portland to Tacoma and Seattle. A three unit hybrid 5,600-hp. diesel locomotive was put together, and now, since June 18, it has made a daily round trip to Seattle and Tacoma. Since August 13, its schedule has been chopped to 3 hours and 59 minutes northbound, and the excess baggage-mail and express cars taken off the head end and put on a new slow local stop-everywhere, to everybody's satisfaction. The new Train of Tomorrow now carries a mail-baggage car, five of the luxurious new 500-series 44 seat streamliner day coaches; the magnificent Sky View Diner, with 52 seats in the regular and dome levels and in the private dining room; the dome coach, Stardust, that carries 42 reserved coach seats in addition to the free use of the dome seats; a regular parlor car, the dome all-room car Dream Cloud, with 20 room seats; the streamliner *City of Portland* through sleeper and the dome lounge car, Moon Glow. The tourist trade gets a magnificent daily view of Mt. Hood, the Columbia River, the Olympic and Cascade mountains and Puget Sound, and a thrilling streamliner ride as well, with 8 a.m. northbound departure from Portland and a 5 p.m. southbound departure from Seattle. Local response is encouraging and winter traffic promises to increase with the amount and density of northwest clouds and rain to gum up airways and highways. The diesel locomotive was especially assembled for the job. They are of 1947 vintage, and include the A or Lead Unit of 2,000 hp. of the E-7 type and the two B units of 1,800 hp. each. Large water and heating boiler capacity is provided and each of the 6-wheel truck units weigh about 305,000 lbs. The EMD motive power lineup of this train in interchangeable with the *City of Portland* streamliner.

The Northern Pacific is now busy streamlining its two round trip trains in the Seattle-Portland pool, with lightweight sleepers fresh off the new S. P. *Cascade and Shasta Daylight* streamliners and North Coast Limited 4-wheel truck diesels. The Great Northern, as usual, lags behind in both equipment and motive power in its contribution to the pool service, but plans for more lightweight cars and diesels soon. Just how long the U. P. will hold its Astra Dome train to a single round trip daily, when one and one-half or even two round trips is possible if the running time is cut to 3½ hours. Meanwhile, the diesel has invaded the last beautiful stronghold of steam in the west, leaving only the Canadian lines in British Columbia behind times. Pooling of passenger and freight diesels on the Portland-Puget Sound line has already done wonders and within three years steam will be gone from this heavily-used trackage that ties nine railroad routes together in a unique kind of operation. Often 50-60 trains per day use this bottleneck track, the west's most heavily traveled rail line.

Archie Blair, president, Tacoma Chamber of Commerce. A group of Union Pacific officials with Carl Perkins, of Electro Motive Division of General Motors, on the inaugural run of the new train.

Dining in the dome. A really spectacular place to dine.

100,000,000 KWH. AT HARLAN

Six Fulton Diesels in Iowa Municipal Plant Roll Up 220,000 Engine-Hours in 21 Years; New Unit Tops 14 Kwh. Per Gallon of Fuel

By W. H. GOTTLIEB

SIX Fulton diesels in the Harlan, Iowa, municipal power plant have generated more than 108,696,000 kwh. in the 21 years since the first units were installed. In more than 220,000 hours of service, the engines have never once caused a plant outage. Today a new 2,760-hp. unit, largest in the plant, is producing 14 kwh. per gallon of fuel consumed to lead Harlan to greater efficiency and greater profits. This Iowa community of 4,200 population has produced its own power since 1891, when a small steam plant was established. The present building was erected in 1929, at which time three air-injecton Fulton diesels rated at 375 hp., 500 hp. and 625 hp. were installed. All but the smallest engine are still in service. In 1936, the building was extended to accommodate a 1,000-hp. air-injection engine, and two years later the first mechanical-injection unit, a 2,000-hp. Model KS Fulton, was put to work. This was the line-up that carried the expanding load for eight years, including the difficult war period.

The next expansion came in 1946 in the form of another Model KS, a 1,500-hp. unit which replaced the old 375-hp. engine. Finally, in August, 1949, the plant's capacity was raised to 8,385 hp. with the installation of a 2,760-hp., mechanical-injection, 4-cycle, supercharged Model KSS Fulton diesel. This 6-cylinder unit, with 24-inch bore and 28-inch stroke, develops its rated horsepower at 240 rpm. In its first full year of operation, the new engine ran 4,811 hours at loads varying from 57.2 to 70.0 per cent of capacity. In that time, the engine generated 6,316,000 kwh. while consuming 450,510 gallons of fuel, an average of 14.01 kwh. per gallon of fuel. During the same period, the unit used 2,155 gallons of lubricating oil, an average of 6,161 hph. per gallon of lube. With every prime mover in the plant seeing service—including the 21-year-old air injection units—the plant attained an average of 13.26 kwh. per gallon of fuel consumed.

Two factors should be considered which make the efficiency of these diesels even more impressive: First, since the air-injection engines are usually under 12 kwh. per gallon., there is a tendency to use the newer engines even when load factors are not conducive to peak efficiency. Second, the fuel now in use is a 36 gravity oil of comparatively low btu. content which yields approximately .5 kwh. less per gallon than the fuel previously used. The new fuel, however, comes at a delivered price of 8.5 cents a gallon compared with 10.21 cents, a saving of 1.71 cents, which more than compensates for the lesser heating value. The fuel comes from an Omaha refinery just 50 miles away. It is heated at the refinery and unloaded hot into Harlan's underground storage tanks. The oil retains enough heat even in the worst winter weather so that there has been no difficulty in handling with the float-controlled, motor-driven rotary pumps which transfer fuel from storage through meters to the day tanks inside the plant. One interesting feature of the plant is the use of a small motor-driven pump to cool the spray nozzles with fuel oil.

Here Superintendent George J. Woodhouse checks on the operation of the 2,760-hp. Fulton diesel.

There is nothing haphazard about operations at Harlan. Superintendent George J. Woodhouse and Chief Engineer Henry Laube plan carefully to get the greatest economy for the plant's collective owners and at the same time to protect the valuable equipment. Thus, in the case of engine lubrication, there is a simultaneous effort to economize on oil and see that the engines are well lubricated. All the diesels have provisoin for cleaning crankcase oil in Fuller's earth filters, in continuous service during engine operation. Included in the pressure lube system of the KS engines are shell-and-tube oil coolers and motor-driven auxiliary lube pumps. The plant has its own oil-testing equipment, which includes a small centrifuge and a falling-ball type dilution indicator. The lube is tested once a week for dilution, dirt, sedimentation, acid and asphalt. On the basis of these tests, it is determined when filter cartridges need to be changed. The tests also provide clues to other developing problems and generally serve to protect the diesels and reduce maintenance costs. Cylinders are supplied with lube by force-feed mechanical lubricators. Cooling water, too, is checked carefully and in this case tests are made daily to insure that water in the system be kept to a hardness of just one-half grain and a pH between 9 and 10. A pair of 1,500 gpm. motor-driven centrifugal pumps circulate water through the engine jackets, the oil coolers and a new dual spray pond. Make-up water is treated in a zeolite softener and copper sulphate is added daily. Intake air filters and exhaust silencers are housed in brick chambers outside the building. This serves to warm the engine air during Iowa's cold winters. Conveniently mounted on the engines are pressure gauges and multi-point exhaust pyrometers. There are alarms on low water and oil pressure. A new 26-panel switchboard was installed in 1948, complete with electrically-operated circuit breakers and recording voltmeter, kw. meter and watt-hour demand meter as well as all the usual equipment. The 120-volt battery which activates the circuit breakers also provides emergency lighting for the plant. The growth of this plant and its load is an excellent example of planned and controlled development. It was recognized that a larger load than Harlan itself provided would reduce the unit cost of power production and result in greater economies and profits for the

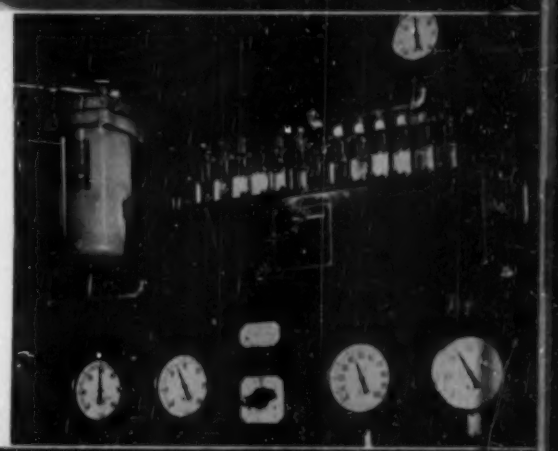
citizens of Harlan. Consequently, the plant contracted to serve the nearby communities of Shelby and Tennant at realistic rates which took all costs into consideration and allowed for a reasonable profit. Also the plant expanded to handle a considerable REA load which, at its peak in 1948, reached 1,100 kw.

But it was not Harlan's intention to run a power system for the entire region with the danger that the city might be left with an over-expanded plant if REA turned to other sources of power. As the city's own demand for electricity increased through normal community growth and the greater popularity of electric appliances, REA was encouraged to plan its own power supply. As a result, the co-op built a plant of its own and reduced its demand on Harlan to approximately 850 kw. Peak loads and kwh. production at the Harlan plant were almost identical in 1948-49 and 1949-50, but the nature of the load was undergoing an important shift. Solid, more profitable city load was replacing lower-rate REA load. It is expected that this shift will continue in the years ahead so that eventually the Harlan diesels will drop REA entirely. Responsible for this development program have been Supt. Woodhouse and a veteran Board of Trustees: H. P. Dowling, chairman, and Morris Frederickson, who have served since 1920, and A. B. Parker, who has been a trustee since 1922. This program has given Harlan an 8,385-hp. power plant with conservative, heavy-duty prime movers capable of producing power with high efficiency and economy. In meeting the demands of the past, these engines have run hundreds of thousands of hours and produced well over a hundred million killowatt-hours. Today, bolstered with new, modern generating equipment, the plant is prepared to meet with even greater efficiency the demands of the future.

List of Equipment

Air Filters—Reed Air Filter Co.
Auxiliary Lube Pump—Tuthill Pump Co.
Batteries—Exide.
Cooling Water Pumps—Peerless.
Engines—6 Fulton Diesels. New engine is 6-cyl., 24x28-in., 240-rpm., 4-cycle, mechanical injection, supercharged 2,760-hp. diesel.
Exhaust Pyrometers—Brown Instrument Co.
Exhaust Silencers—Fulton Iron Works Co.
Fuel—Searle Petroleum Co.
Fuel Filter—Wm. W. Nugent & Co., Inc.
Fuel Meter—Pittsburgh Equitable Meter Co.
Fuel Transfer Pump—Worthington Pump and Machinery Co.
Generator—General Electric Co.: 2,000-kw., 3-phase, 60-cycle, 2,400-volt generator with 25-kw. motor-generator set as exciter.
Governor—Woodward Governor Co.
Lube Oil—Socony-Vacuum.
Lube Filters—1 Honan-Crane on 2,760 hp.; also Wm. W. Nugent & Co., Inc.
Lube Cooler—Ross Heater & Mfg. Co., Inc.
Lube Testing Set—Gerin Corp.
Pressure Gauges—Jas. P. Marsh.
Softener—Permutit Co.
Switchboard—Westinghouse Electric & Mfg. Co., Inc.
Thermometers—Motoco.

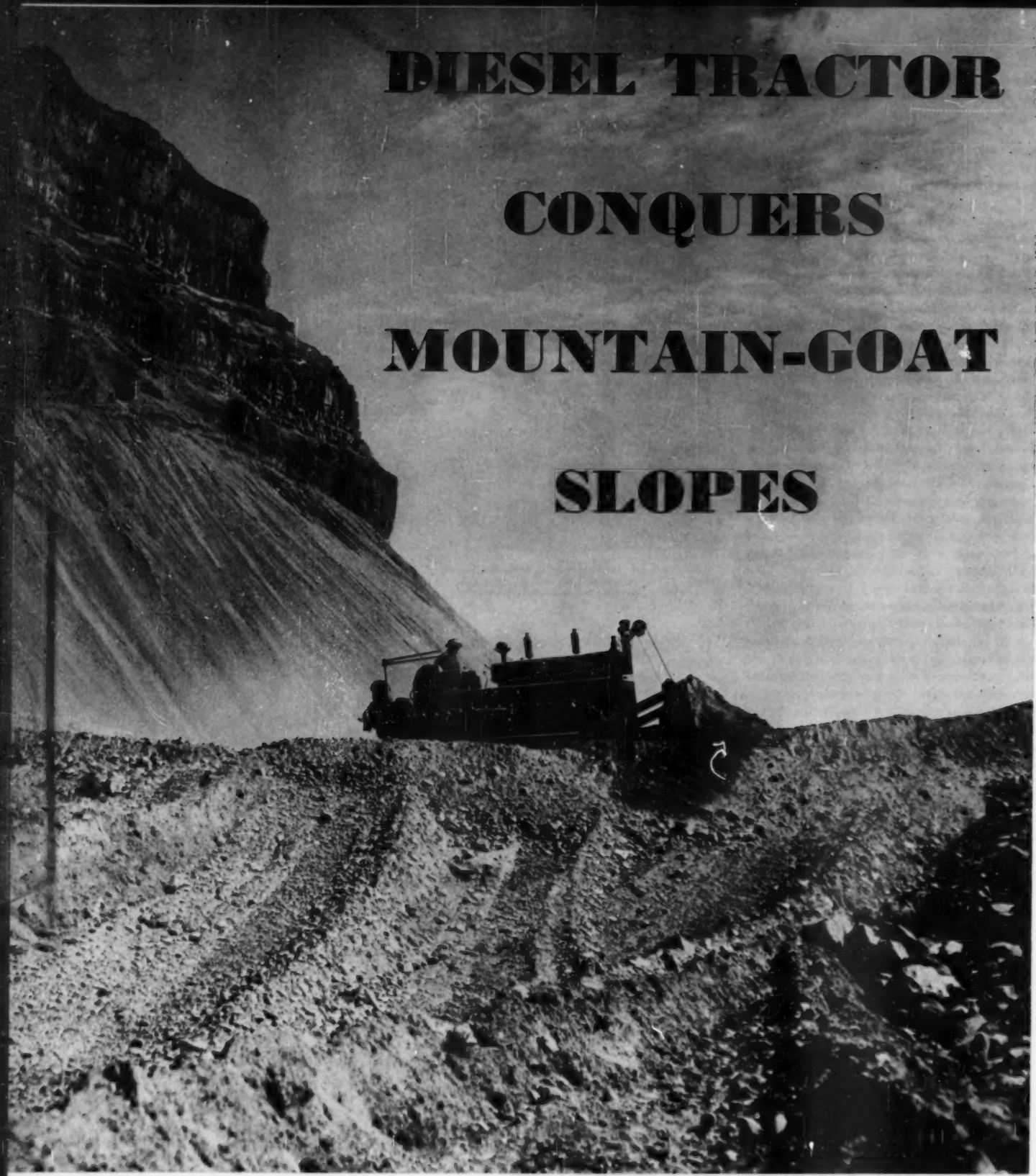
This is the new Westinghouse switchboard installed in 1948. It has electrically-operated circuit breakers powered by 120-volt Exide battery.



This closeup of the 2,760-hp. Fulton shows the Jas. P. Marsh pressure gauges, Manzel cylinder lubricators, Brown exhaust pyrometers and Nugent filter.

This view of the Harlan, Iowa, municipal power plant shows four of the six Fulton diesels in operation there. In the 21 years since the first units were installed the engines have generated more than 108,696,000 kwh.

DIESEL TRACTOR CONQUERS MOUNTAIN-GOAT SLOPES



DAN COLE eased his giant International TD-24 diesel crawler through a notch at the top of the cliff and lowered the dozer blade. Seven hundred feet below him he saw the mighty Columbia River. As the front of the tractor dropped further he found himself looking over the radiator cap directly down the 70-degree slope of a huge talus slide with rocks loosened by the dozer slipping and falling out of sight. Powerful tracks churned the loose rock as his dozer blade bit into the steep slope, carving a place for the tractor to level itself. In a few seconds, 25 tons of crawler and bulldozer was safe on a ledge of its own making. From then on it was a simple matter for Dan to carve a wide bench from which two TD-24 tractors could work the mass of rock down to the 400-foot level.

Dan had begun to remove the grandfather of all Columbia River talus slides—a mass of two-thirds of a million cubic yards of loose rock which hung

Two TD-24's International Harvester diesel tractors with Bucyrus-Erie bulldozers work the talus down from the 700-foot to the 400-foot level.

poised over the river for thousands of years. Removal of the big slide and several others was a problem faced by Gibbons and Reed Construction Company of Salt Lake City on their contract calling for relocation of the roadbed of the Spokane, Portland and Seattle Railroad, which follows the canyon of the Columbia. How could this mass of loose material be worked down safely and economically? If removal of the slide was miscalculated, machinery might be buried, lives of men working on the project endangered, and a mass of rock deposited on the railroad track, which must be kept open. A. V. Toolsen, Gibbons & Reed superintendent, was convinced he had the answer. Thorough inspection revealed a core of soft material in the cliff at the very top of the slide. A careful man with a bulldozer could build a road through this narrow opening to reach the talus from the top. Once a bench was begun there, the rest was relatively easy. Toolsen gambled—and won—on his conviction that his veteran operator, Dan Cole, could work his TD-24 diesel crawler safely up and down the mountain-goat slopes.

Once the bench was made by Cole, the rest of the job, though presenting no tremendous difficulties, was spectacular enough. The two International TD-24's working the talus down from the 700-foot to the 400-foot level could not be removed from the bench until they had finished the job. A cache of fuel and lubricants was built up at the start of the job, and for the ten days required to see the job through, tractor operators were lowered to the job with ropes and climbed out hand over hand. When the 400-foot level was reached, the tractors could get down by a road which had been cut out of the side of the cliff to that height. The roar of powerful diesels even now fills the gorge of the Columbia, but there is little doubt that the Gibbons and Reed contract completion date of December 1, 1950, for relocation of the bed of the Spokane, Portland and Seattle railroad will be met. Failure to meet this date would delay the opening of McNary Dam, newest link in a series of dams which will control the rampaging river. For a comparatively short river, the Columbia carries a terrific volume of water from high in the Cascade mountains to the Pacific. In ordinary years, mountain snows melt gradually and the Columbia's yearly flood is a minor matter, causing only a few million dollars in property damage. But sometimes a few weeks of early spring warm weather will send a tremendous amount of water down river, causing extensive damage and, not infrequently, loss of life. McNary will help control the floods, and will be a large producer of water for irrigation and electric power as well. Eventually the Columbia Basin Project is expected to be the largest irrigation development in the world.

In the background is the cache of fuel and lubricant used to supply the International TD-24's working on the talus slide. This illustrates steepness of the slide.

"GOOD NEIGHBOR" -- DIESEL DRIVEN

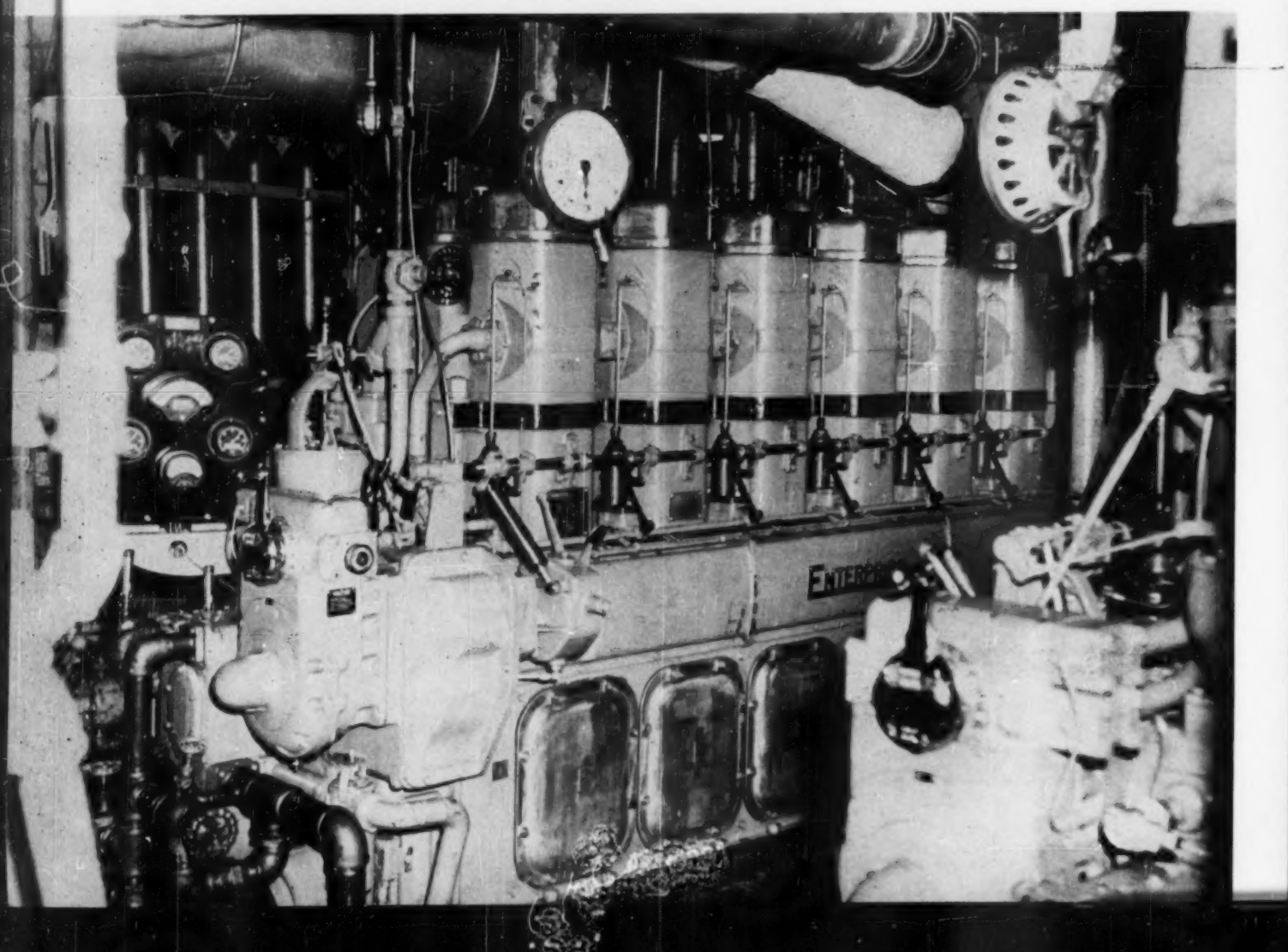
By RICHARD LaCOSTE

PERHAPS the most famous of the former yachts now used for business is the *Good Neighbor*. She was originally built in 1930 at a cost of $730,000 for Bill Fisher, of Fisher body fame. All four Fisher brothers were bitten by the the boat bug: they owned little boats and big boats and medium-sized boats. But they shot the works when they ordered the 153-foot, twin diesel driven *Good Neighbor*. She was fast for her day and age and truly a sportsman's sight to see. Many a millionaire enjoyed her underfoot. Hundreds of dignitaries and personages knew her well.

Came Pearl Harbor, like many another boat, yacht, schooner and ship, she answered the call of her country. Soon after the Japs signified their intention of abiding by the Potsdam agreement in August of 1945 she was placed on the surplus list. The *Good Neighbor* was then interned at Halifax. Just about this time New Orleans was flirting with the idea of building an International House, rendezvous for a trade-boosting organization whose fame today has spread throughout the commercial world. The city needed just such a ship. New Orleans wanted a ship on which to entertain prospective buyers the while they sailed on the Mississippi River. The far-sighted city fathers decided to buy the yacht and purchased it for a nominal sum. The Board of Commissioners, Port of New Orleans, closed the deal and sent Captain John A. Rucker to Halifax to bring her home. In the four years she carried political dignitaries and financial tycoons up and down the famed river, Captain Rucker has estimated she has travelled a distance half the circumference of the world and carried some 16,000 passengers.

Like many of her famed sister yachts of the '20's, the *Good Neighbor* was powered with a pair of Winton diesels. Although excellent marine power plants, they could not be expected to last forever. They did their duty and well. But, fearing that the yacht might be laid up too frequently for lack of spare parts for the venerable engines, the Board of Commissioners decided to re-power her. Bids were invited from engine builders and distributors. Shipyards and shops capable of such work were solicited for installation bids. The contract for two new engines went to the New Orleans branch of the Enterprise Division of San Francisco. The New Orleans branch is known as the Enterprise Engines, Inc., and is managed by Paul Wabnig. The installation contract went to an old New Orleans firm of Thomas W. Hooley & Sons. Once the contracts were firmed up, work started and Enterprise delivered the engines, Hooley installed them and rebuilt the cabin trunk. Auxiliaries such as diesel generating sets and compressors were supplied by Wm. F. Surgi Equipment Company, also of New Orleans. According to W. F. Robinson, a Board of Commissioners spokesman, "Counting the two new engines and conversion work on the yacht after this Board bought it as war surplus, we have spent about $200,000 on new engines, decorations, etc. The engines cost approximately $50,000 apiece installed." The yacht originally cost Mr. Fisher $730,000.

Main engines on the *Good Neighbor* are Enterprise. The type used are six cylinders, 12-inch bore by 15-inch stroke, turbocharged to develop 450 hp. at 325 rpm. It features a built-in Kings-



President Gabriel Gonzales Videla, of Chile, is shown at left as he toured the harbor of the port of New Orleans aboard inspection yacht *Good Neighbor*. With him is R. Kirby Loagino, vice president of the Board of Commissioners of the Port of New Orleans, who acted as his host and guide during the trip.

Captain John A. Rucker, of the yacht *Good Neighbor*, harbor inspection vessel of the Board of Commissioners of the Port of New Orleans. A licensed river pilot, Capt. Rucker heads a crew of seven men who operate the 155-foot yacht.

bury thrust and oil cooled pistons. The auxiliaries are two U. S. Motors generating sets of 30 kw. each, 125 volts, 240 amps., which are driven by Hercules 5-cylinder, 4¼x4¾-inch bore and stroke diesel engines rated at 69 hp. at 1,200 rpm. The first trial was witnessed by political and industrial men. Included were: Harry L. Hanson, chief engineer; Walter Swall and Algor Green, service engineers; and Paul Wabnig, district manager—all of the Enterprise Company; Herbert F. Nolan, naval architect of the John H. Wells firm, New York, who supervised the re-powering project; and Thomas W. Hooley, Jr., of the firm that made the installation. At the trial run, the *Good Neighbor* showed a pool-water speed of approximately 16 knots, and running downstream in the Mississippi was judged to be making over 20 miles per hour.

Captain Rucker didn't have to be asked how the *Good Neighbor* performed with its new power plant. "Biggested difference in the world," he said.

DIESEL + STEAM + HYDRO

The Montana-Dakota Utilities Co. Installs Four 2,430-hp. Lima-Hamiltons to Meet Immediate and Long Range Needs of Diesel-Steam-Hydro System

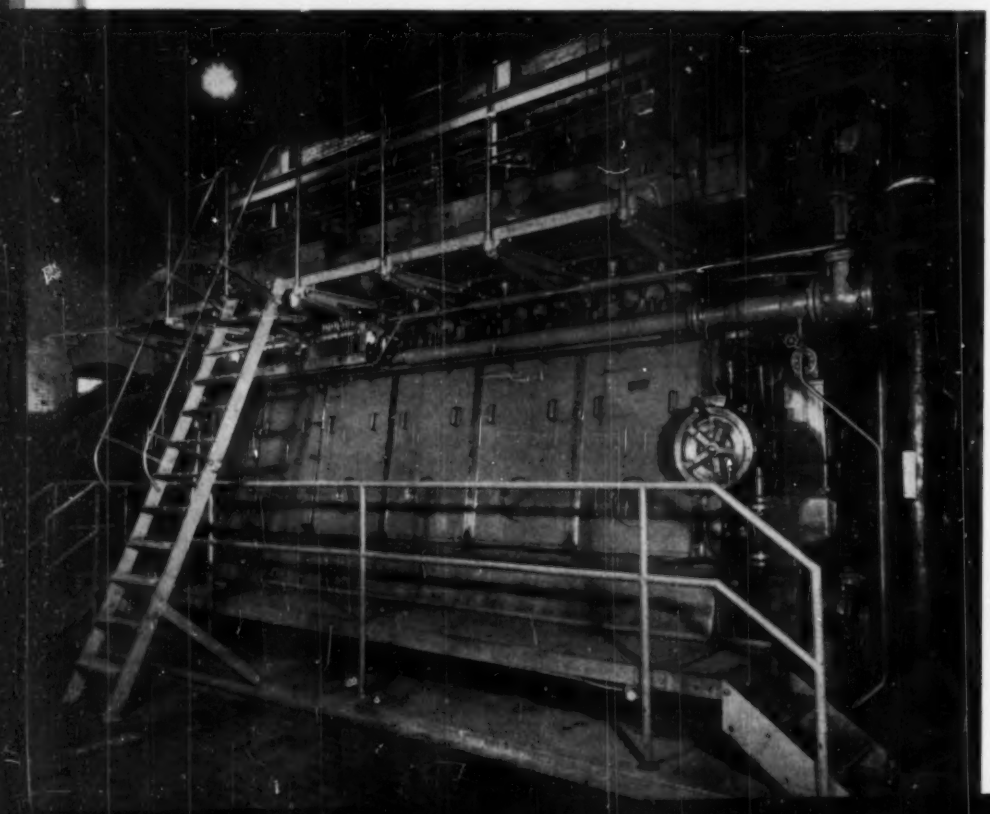
By W. H. GOTTLIEB

THE Montana-Dakota Utilities Co., with far-flung lines serving portions of four states in the upper Missouri basin, is demonstrating the value of diesel engines in a growing, complex power system. For nearly three years, four 2,430-hp. Lima-Hamilton diesels have been producing urgently-needed power to help the company's steam plants carry the expanding load. In the future, when the U. S. Bureau of Reclamation's huge Missouri River dams and hydro plants are completed, the diesels, together with the company's steam plants, will provide an efficient and economical means of firming up the hydro power supply and regulating voltage.

The Montana-Dakota Utilities Co. dates back to the year 1924, when it was founded by its now president, R. M. Heskett. At that time the company purchased the Eastern Montana Light and Power Company, which served six communities in eastern Montana and western North Dakota. During the next 21 years the company extended its electric operations through eastern Montana and western North Dakota. Late in 1945, it purchased the properties of Dakota Public Service Company, which then furnished electric service to 94 communities in the western Dakotas. The following year the electric property at Linton, N. D., was acquired and, in 1947, the company purchased the electric properties of the Sheridan County Electric Company, which extended its operations into Wyoming. The growth of electricity consumption in the Dakotas, Montana and Wyoming in recent years has been truly phenomenal. As recently as 1942, the company sold only 35,195,446 kwh. In 1949, just eight years later, sales were up to 191,223,708 kwh. For the 12 months ending July, 1950, the figures stood at 208,455,560 kwh. In part this was the result of company expansion to reach new customers. Starting with 8,021 customers in the year 1926, the company listed 19,048 in 1942 as compared to 58,187 in 1949 and 58,772 in the 12 months ending July, 1950. The list of communities served has grown from 56 in 1926 to 231 in 1950. In part, the growth of the electric load was increased consumption by the individual customers in city homes, on farms, in stores and industry. The residential consumer increased his use of electricity from an average of 824 kwh. for 1942 to 1,772 kwh. for 1949.

To meet this burgeoning demand for power, Montana-Dakota Utilities Co. conceived and executed a bold yet astute development program designed to meet immediate needs and still fit into the pattern of the government's regional plan. The steam turbine is a logical prime mover here for the region is rich in cheap lignite coal. In fact, the utility company itself mines coal through a wholly-owned subsidiary, the Knife River Coal Mining Co. But power was needed with all possible speed and diesels could be installed and put into service in far less time than it would take to build a steam plant. Company officers also took into consideration the fact that eventually government-produced hydro power, which is supplied at several points on the company's system, would take over the base load and that it would then be the prime function of the company's own plants to firm up hydro power. Here again, diesels offered important advantages: They could be started up in a matter of minutes and would burn no fuel while waiting the call to service. Also in these Northern states, dependable and strategically placed stand-by units are specially important because winters are severe and transmission lines exceedingly long. To accomplish these varied objectives, the company purchased in 1947 four heavy-duty, two-cycle Lima-Hamilton diesels, each of 6 cylinders, 21½-inch bore and 27½-inch stroke, developing 2,430 hp. at a slow 240 rpm. The first unit was put into service at Ellendale, N. D., in September, 1947, the second in the same plant in October, 1947. The third and fourth units were put in operation at Mobridge, S. D., in December of the same year. Since these dates, the diesels have been major power producers. By the end of September, 1950, the four engines had run a total of 38,224 hours and produced 42,996,710 kwh. Fuel oil consumed totalled 3,128,477 gallons for an average of 13.74 kwh. per gallon. It should be noted that this excellent fuel consumption is by no means the best of which the plants are capable. The load factor averaged just under 65 per cent. In periods when the engines were well loaded, production was as high as 14.6 kwh. per gallon. But the plants are operated not to achieve maximum efficiency at these isolated stations but to attain the greatest economy for the system as a whole. Thus, some of the larger coal-burning steam plants carry the base loads while the diesels handle the peaks, whether or not they constitute efficient loads for the engines. Also, on occasion, the diesels are run to pick up the voltage, performing a useful service for the system, though actual power production would be far below the engines' most economical operating level.

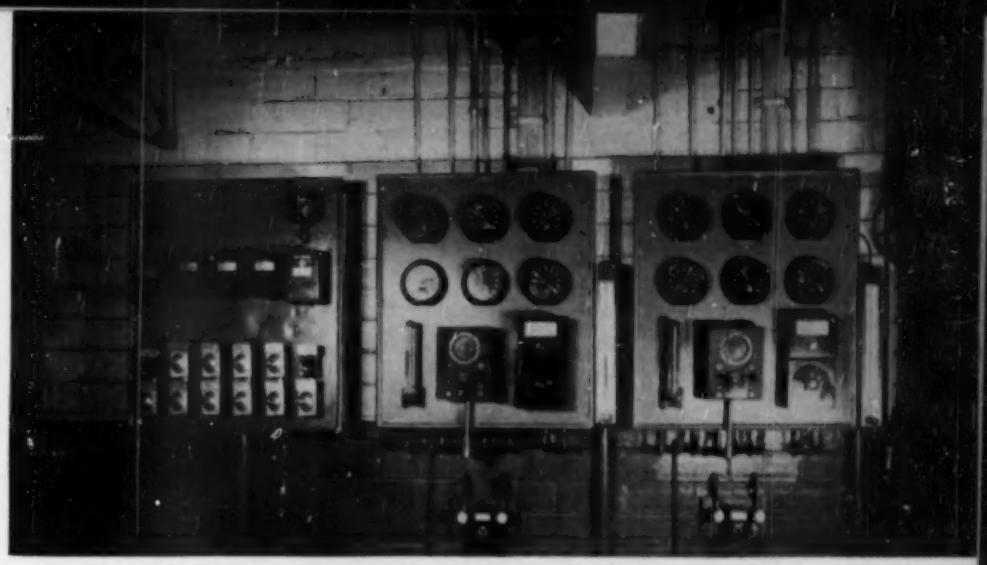
Coal is in home ground, but oil for diesel fuel must be transported long distances. Freight charges bring the delivered price at this writing to 12.3 cents a gallon for the No. 2 oil now in use. The engines are capable of utilizing crude oil and, with relatively minor changes, both plants can be



The Lima-Hamilton diesels are used by the Montana-Dakota Utilities Co. to supplement the system's steam plants. Despite the fact that the load factor for the diesels averaged less than 60 per cent, the engines have produced an average of 13.74 kwh. per gal. of fuel—and as high as 14.6 kwh. per gal. when well loaded. All the diesels are equipped, like this engine in the Mobridge, S. D., plant, with Woodward governors and Manzel cylinder lubricators.

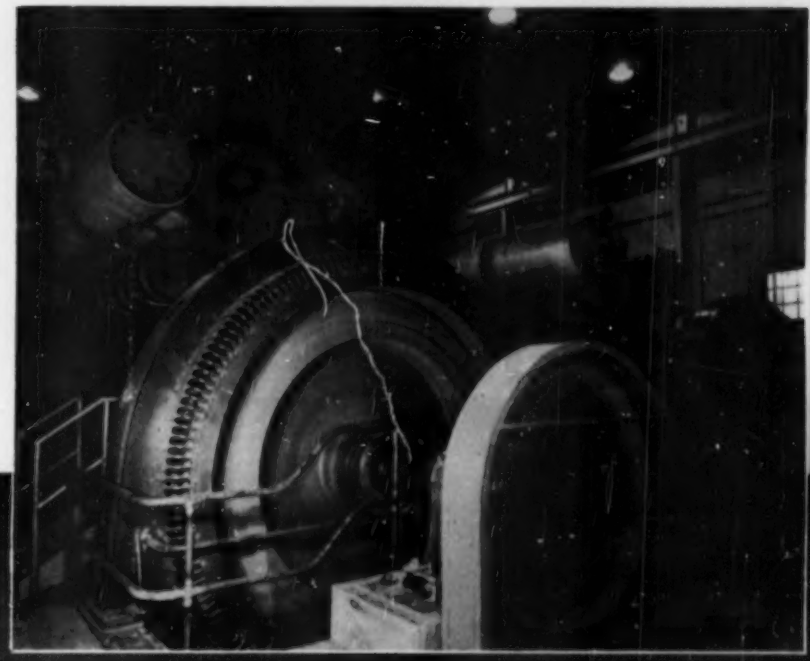
adapted to handle heavy fuel. At Ellendale, for example, fuel is unloaded from tank cars by a motor-driven rotary pump into two 50,000-gallon storage tanks equipped with steam heating coils. From storage the oil flows by gravity to a centrifuge, then through a meter to a 5,000-gallon day tank also equipped with steam coils. From this tank, motor-driven gear pumps deliver the oil through duplex cartridge-type filters to the engine injection systems. Still another heating device has been provided—a steam heat exchanger through which fuel from the day tank can be pumped and returned to the tank. Straight mineral lubricating oils are used in both plants, a 30 weight oil in the crankcase for the pressure circulating system that lubricates the bearings and cools the pistons. A 50 weight oil is fed to the cylinders by force-feed mechanical lubricators. From the pressure side of the circulating pump, some oil is drawn off for purification, first by a centrifuge and then by a multiple-cartridge filter with cellulose elements. There is also a motor-driven pump to permit cleaning of batches of oil. Each engine has a shell-and-tube oil cooler and a motor-driven auxiliary lube pump . Periodically, samples of lube are subjected to laboratory examination and purification procedure is adjusted in accordance with the results. Condition of the oil has been excellent, with very little fuel dilution and only a few seconds drop in viscosity. At Mabridge, pistons were pulled after about 4,000 engine hours to check on engine condition and appraise the effectiveness of lubrication. The engine was found to be clean and evidences of wear very small. On the basis of this check, it is felt that it will not be necessary to pull pistons oftener than every 9,000 engine hours. Both plants have a very convenient means of handling lube make-up. Oil is pumped from drums into supply tanks inside the engine room. There are pipe connections from one tank to the engine pumps and from the other to each cylinder lubricator so that it is possible to add oil as required merely by opening and closing valves.

Both plants have closed cooling systems but equipment and water handling differ. At Ellendale, jacket water for each engine is circulated by a motor-driven 450-gpm. centrifugal pump from the diesel through an evaporative cooler, through the lube cooler and back to the engine. Just 300 gpm. is put through this circuit with the remaining 150 gpm. going right back into the engine jackets. Make-up water with only 3 grains of hardness is supplied to the jacket system surge tank by a float-controlled motor-driven well pump. Automatic thermostatic controls regulate the setting of the louvres on the evaporative coolers to keep jacket temperature at an inlet of 132°F. and an outlet temperature of 140°. There is one circulating pump for each engine with a third as a standby. At Mobridge, a similar set of pumps circulates water through engine jackets and heat exchangers. Motor-driven centrifugals put raw water through the exchangers and a two-cell induced-draft cooling tower. Treated Missouri River water is purchased for make-up.

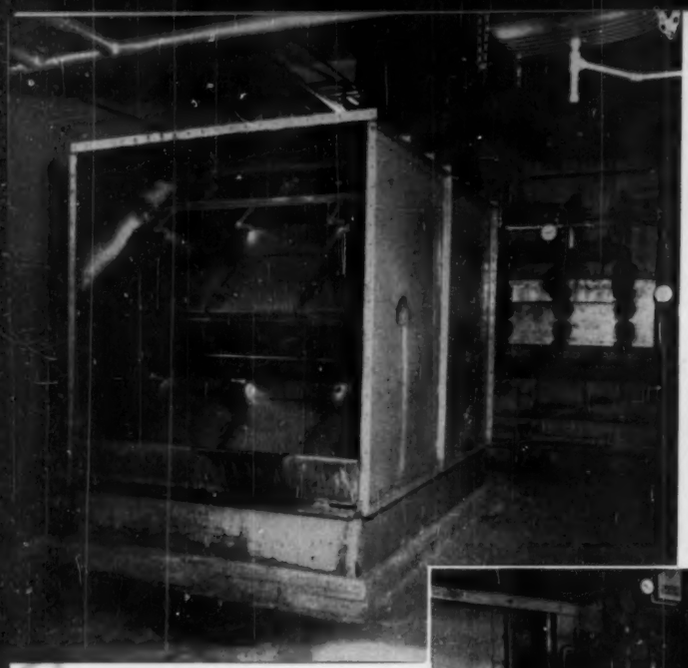


In both the Ellendale and Mobridge diesel plants there is a gauge and alarm panel for each engine. At the Mobridge installation each panel holds an Alnor multi-point exhaust pyrometer and alarms on lube pressure and cooling water pressure and temperature. The panel (left) at Mobridge holds control switches for all auxiliary equipment, so the engines can be started from this board.

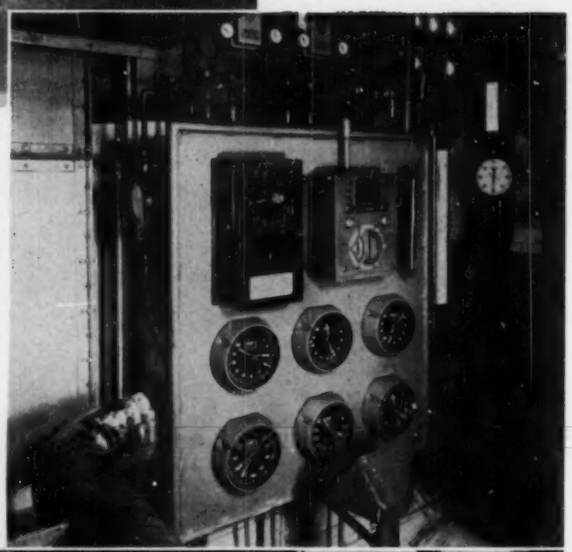
The two Lima-Hamilton diesels in Mobridge, S. D., plant drive General Electric generators.



At the Mobridge plant two Marley induced draft cooling towers are used. One for the steam plant which is shown here, and the other for the diesel plant, located at the other side of the building.

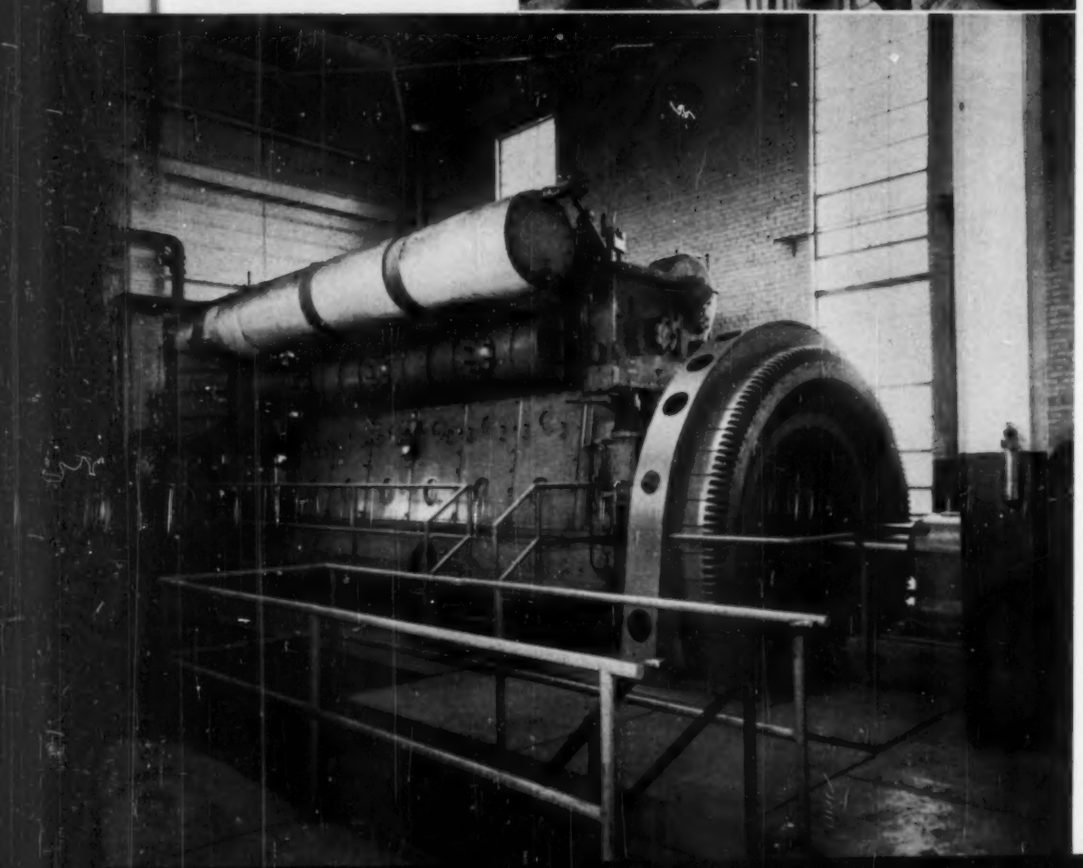


Buffalo Forge air-washer filter in foreground and in the background is the Buffalo Forge evaporative cooler used on the jacket water.



At Ellendale the Pacific Diesel & Engineering Co. alarm panels are located close to the engines. Each is equipped with an Alnor pyrometer.

All the Lima-Hamilton diesels of the Montana-Dakota Utilities Co., like this engine at Ellendale, N. D., are blower-scavenged.



To facilitate cold weather starting and protect the engines, each plant has means for heating jacket water with steam. At Mobridge, a separate motor-driven centrifugal pump circulates the water through a heat exchanger and a thermostat regulates the steam admission valve. At Ellendale, the water goes through coils in a steam heater. When the engine is in operation a blower sends air across the coils and utilizes waste jacket water heat to heat the building. To provide starting air, there are two compressors, one driven by a gasoline engine, the other by a motor automatically controlled to keep air tanks at 400 psi. The normal starting range for these engines is between 250 and 400 lbs., but the operators report starting the units with as little as 150 lbs.

The Lima-Hamiltons are blower-scavenged diesels. Scavenging air is supplied to the engines by high-speed motor-driven rotary blowers with an output of 10,800 cfm. at 3.25 psi. At Ellendale, the air is cleaned in air-wash filters, passing first through a water spray, then through spun glass filtration elements, and finally past eliminator plates to take out the water before the air reaches the suction of the blower. There is one such filter unit with a capacity of 12,600 cfm. for each engine. At Mobridge, each diesel is served by an automatic, self-cleaning, oil bath air filter. At both Mobridge and Ellendale raw water runs through an air cooler to keep scavenging air temperatures between 100 and 110°F. Exhaust gases vent through vertical silencers outside the plant.

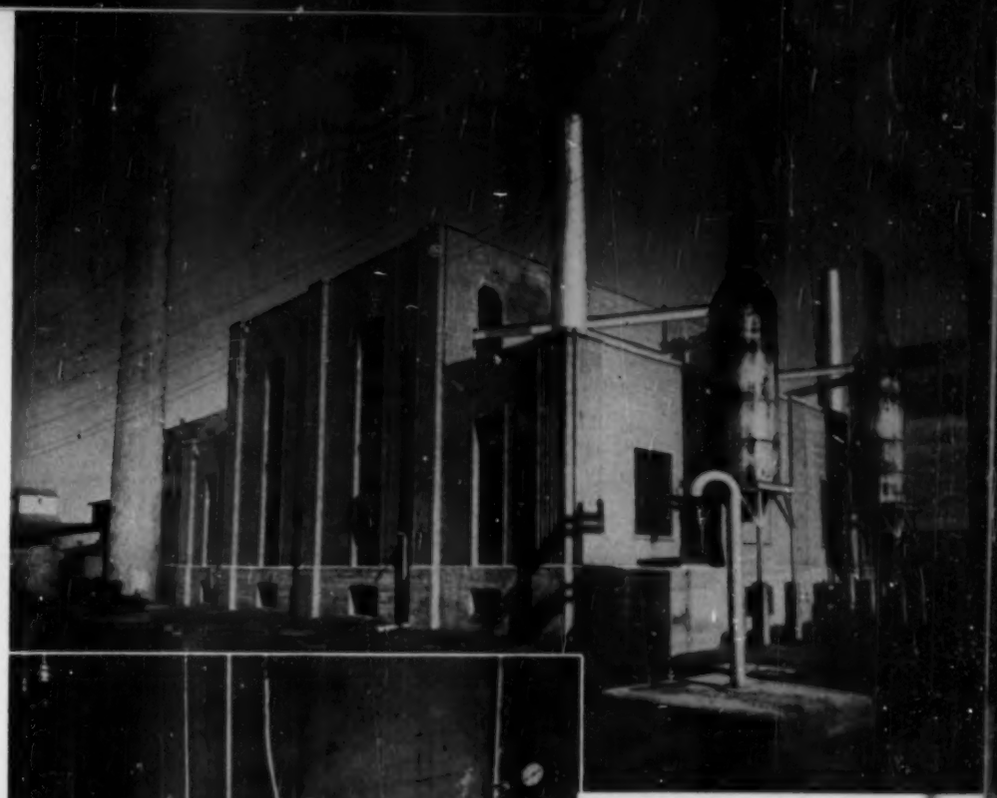
Each of the four engines has a gauge and alarm panel which holds a multi-point exhaust pyrometer and alarms on lube pressure and cooling water pressure and temperature. At Mobridge there is an additional panel with control switches on all engine auxiliary equipment so that the engine can be started from this board. The unit-type, metal clad switchboards have interlocking devices which make it impossible for the operator to close the generator switch unless the synchronizer switch is on. All the circuit breakers are solenoid operated with a wet cell battery providing current for the breakers and for emergency lighting. Montana-Dakota Utilities provided itself with dependable, heavy-duty prime movers and follows a methodical preventive maintenance routine to keep the equipment in peak operating condition. As a result, there have been no major repairs. This company's operations are of particular interest as a demonstration of the part internal combustion engine can play in a coordinated power system which includes both steam and hydro. Forward-looking management utilized diesels to meet an immediate demand, but these are not slap-dash emergency facilities but, rather, sound, efficient power stations capable of producing kwh. at a profit. Today all four engines commonly run from 7 a.m. till 11 p.m. Meanwhile, the company proceeds with expansion of its base-load steam stations, now having under construction an 8,500 kw. steam plant at Mobridge. In future years, when hydro power is available in greater quantities, the diesels will stand ready for instant service in case of line failure or voltage drop. A dry season would call for protracted service. But this is an expanding economy and a region which already has out-

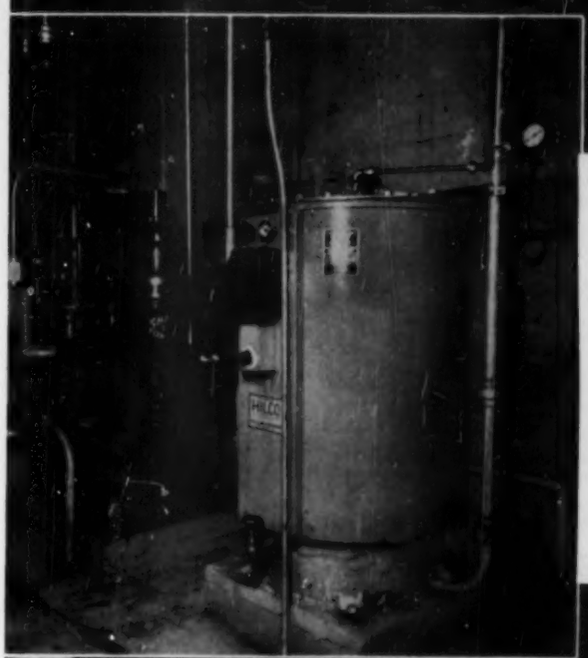
stripped all predictions for electricity consumption. Whatever the situation, Montana-Dakota is preparing to meet its customer demands.

The company, under the guidance of its president, R. M. Heskett; Cecil W. Smith, vice president; F. R. Gamble, treasurer; and W. L. Hayes, secretary and general sales manager, has been an important factor in the development and stabilization of the area in which it operates, and the company's progress has been a tribute to the judgment and foresight of the management and its confidence in the potentialities of the territory. Besides its interests in electric business, the Montana-Dakota Utilities Co. is also engaged in the natural gas business. Starting in 1926 the company has expanded its gas operations—developing new fields and building new lines—until in the 12 months ending July, 1950, it sold 17.4 million cubic feet of gas to 41,833 customers. Today it has an investment in electric and gas facilities of approximately $60,000,000, including over 1,500 miles of high pressure gas transmission lines, 2,800 miles of high voltage electric transmission lines and ten principal power generating plants. Engineering and design of the diesel installations at Mobridge and Ellendale were done by C. M. Garland and Co., of Ingleside, Ill., and the construction was carried on under the general direction of H. L. Pearson, assistant vice president of the Montana-Dakota Utilities Co. Both plants are in the Mobridge Division of the company, of which B. W. Durant is division manager and N. S. Patterson electrical superintendent. Bruce Harris is chief engineer of the Mobridge plant and Clark Gillespie holds that position at Ellendale.

List of Equipment

Diesels—Four 6-cyl., 21½x27½-in., 240-rpm., 2-cycle, 2,430-hp. Model 621 SA diesels. Lima-Hamilton Corp.
Generators—General Electric Co.
Governors—Woodward Governor Co.
Fuel Centrifuge—Sharples Corp.
Fuel Filters—Wm. W. Nugent & Co., Inc.
Steam Heat Exchanger—Graham Mfg. Co.
Fuel Meters—Bowser, Inc.
Lube Oil—Socony-Vacuum Co., Vacme No. 3 and Vacme No. 5, Texaco Algol, Texaco Ursa P50, The Texas Co.
Lube Centrifuge—Sharples Corp.
Lube Filters—The Hilliard Co. and Purolator Products, Inc.
Lube Coolers—Graham Mfg. Co.
Cylinder Lubricators—Manzel, Inc.
Heat Exchangers—Graham Mfg. Co.
Evaporative Coolers—Buffalo Forge Co.
Steam Exchanger—Graham Mfg. Co.
Room Heater—Buffalo Forge Co.
Cooling Tower—The Marley Co.
Scavenging Air Blowers—Allis-Chalmers Mfg. Co.
Air Filters—Air-wash type—Buffalo Forge Co.; and Oil-Bath Type—Dollinger Corp.
Exhaust Silencers—Maxim Silencer Co.
Air Compressors—Quincy Compressor Co.
Switchboards—General Electric Co.
Alarm Panels—Pacific Diesel & Engineering Co.
Exhaust Pyrometers—Alnor, Illinois Testing Laboratories.
Batteries—Philco.

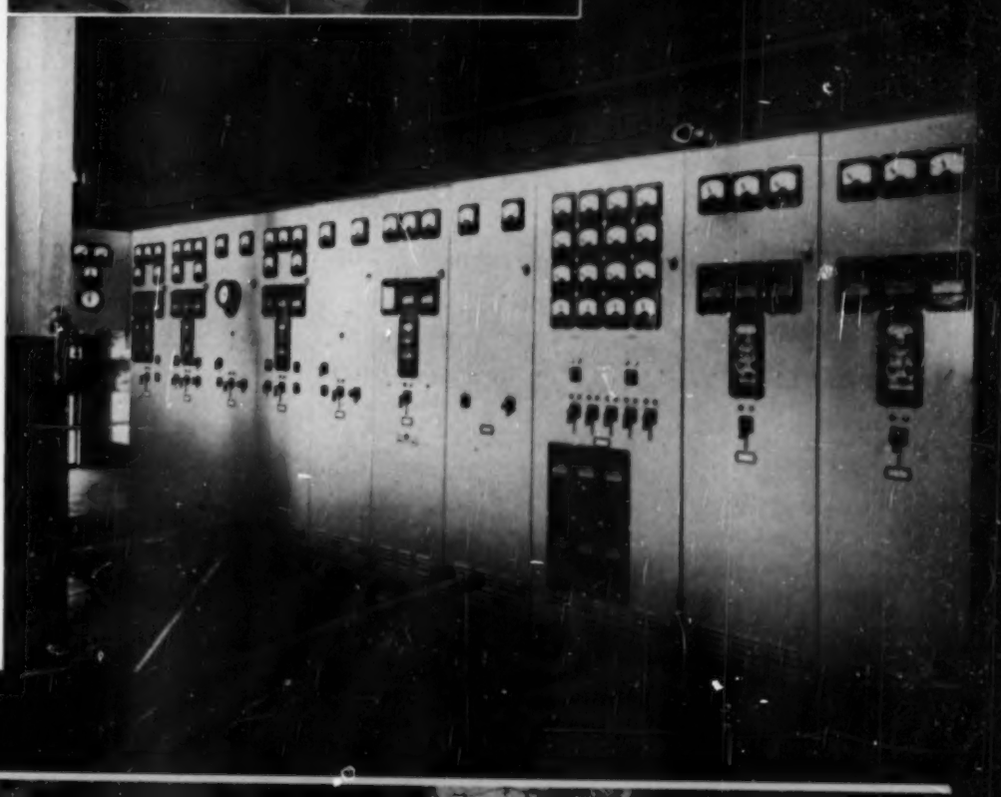




These two Maxim silencers are located at rear of Ellendale plant.

The system of lube purification at the Ellendale plant is typical of both diesel installations of the Montana-Dakota Utilities Co. The 30 weight oil used for the bearings and pistons is drawn off for cleaning, first by a Sharples centrifuge and then by a Hilco multiple-cartridge filter with cellulose elements.

This shows the General Electric switchboard at the Ellendale, N. D., plant.



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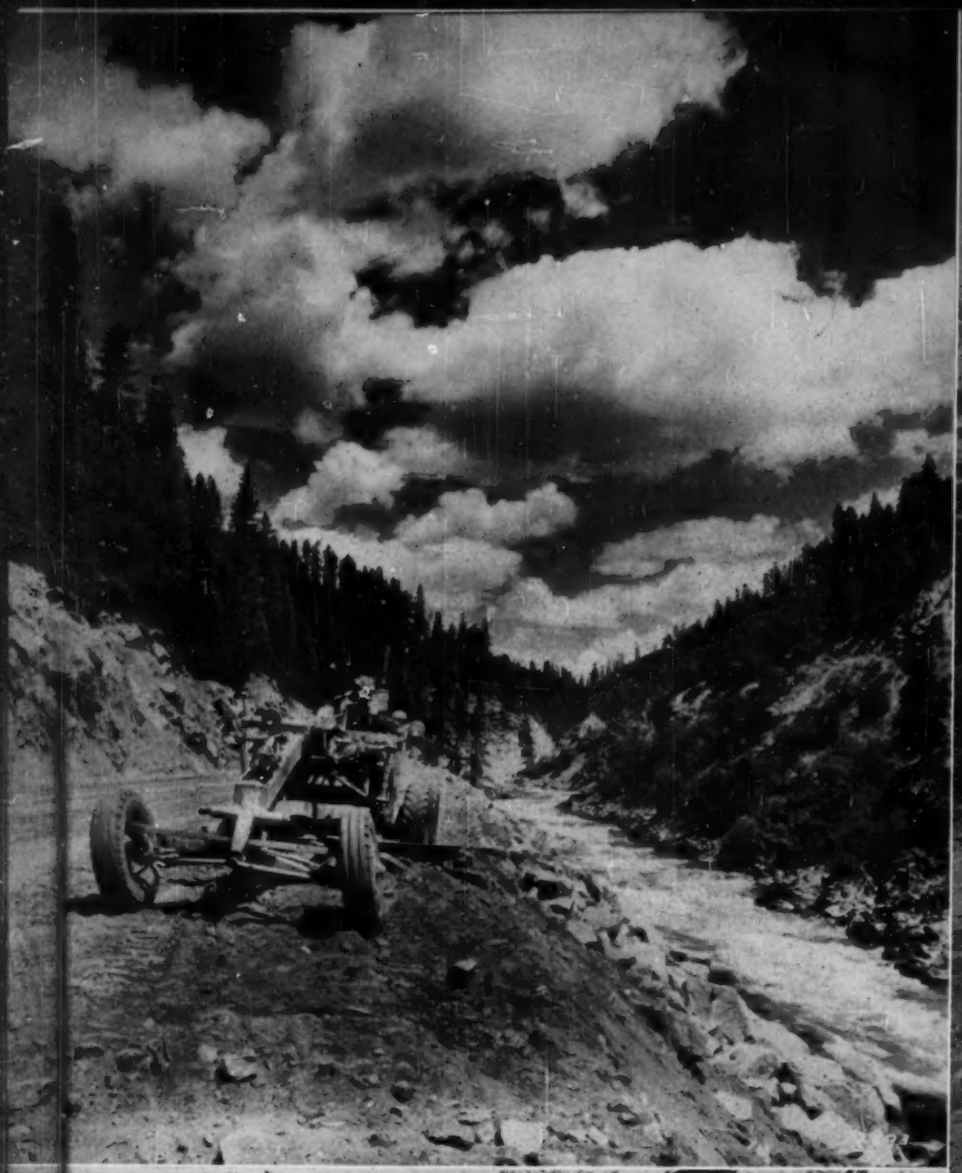


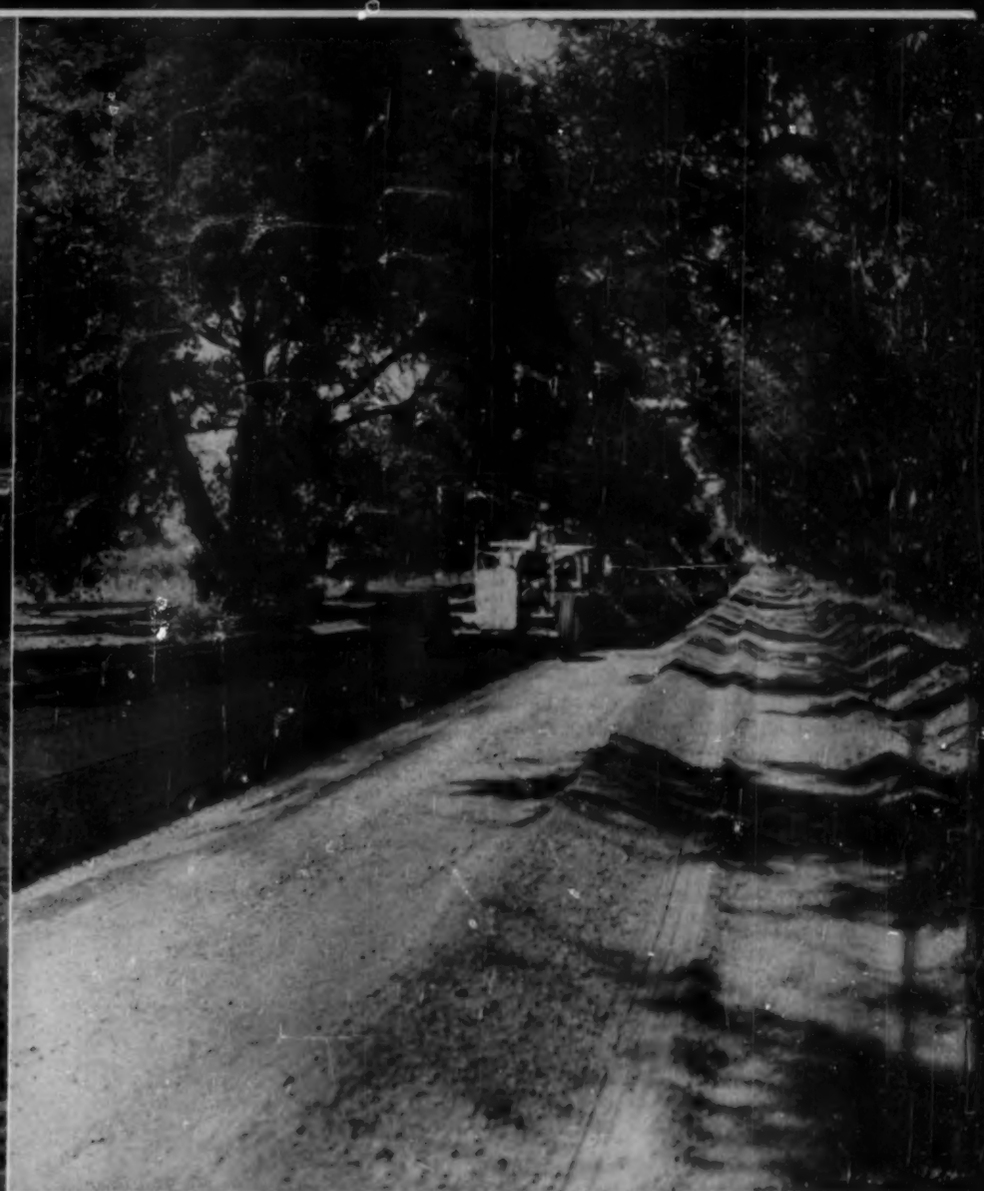
Caterpillar diesel D8 tractor equipped with
dena, Calif., overlooking the Rose Bowl. L

Caterpillar diesel No. 12 motor grader working on road construction job on State Highway No. 15 along the Payette River 15 miles north of Banks, Idaho. Other Caterpillar equipment on this job includes D8 tractor with bulldozer and a D13000 engine powering a Gardner Denver compressor.

Caterpillar diesel D2 tractor pulls wagon with the apple blossom queen and her court on tour of the orchard near Peshastin, Washington.

SEL APPLICATIONS

ulldozer levels hillsides northwest of Pasa-
el area to be used for building purposes.



Caterpillar diesel No. 12 motor grader spreading oil mixed material on highway No. 40 near Vacaville, California.

Caterpillar diesel D7 tractor equipped with bulldozer, with special built-up blade, piling storage coal and dozing coal to plant for the Utah Power & Light, Orem steam electric plant at Orem, Utah.

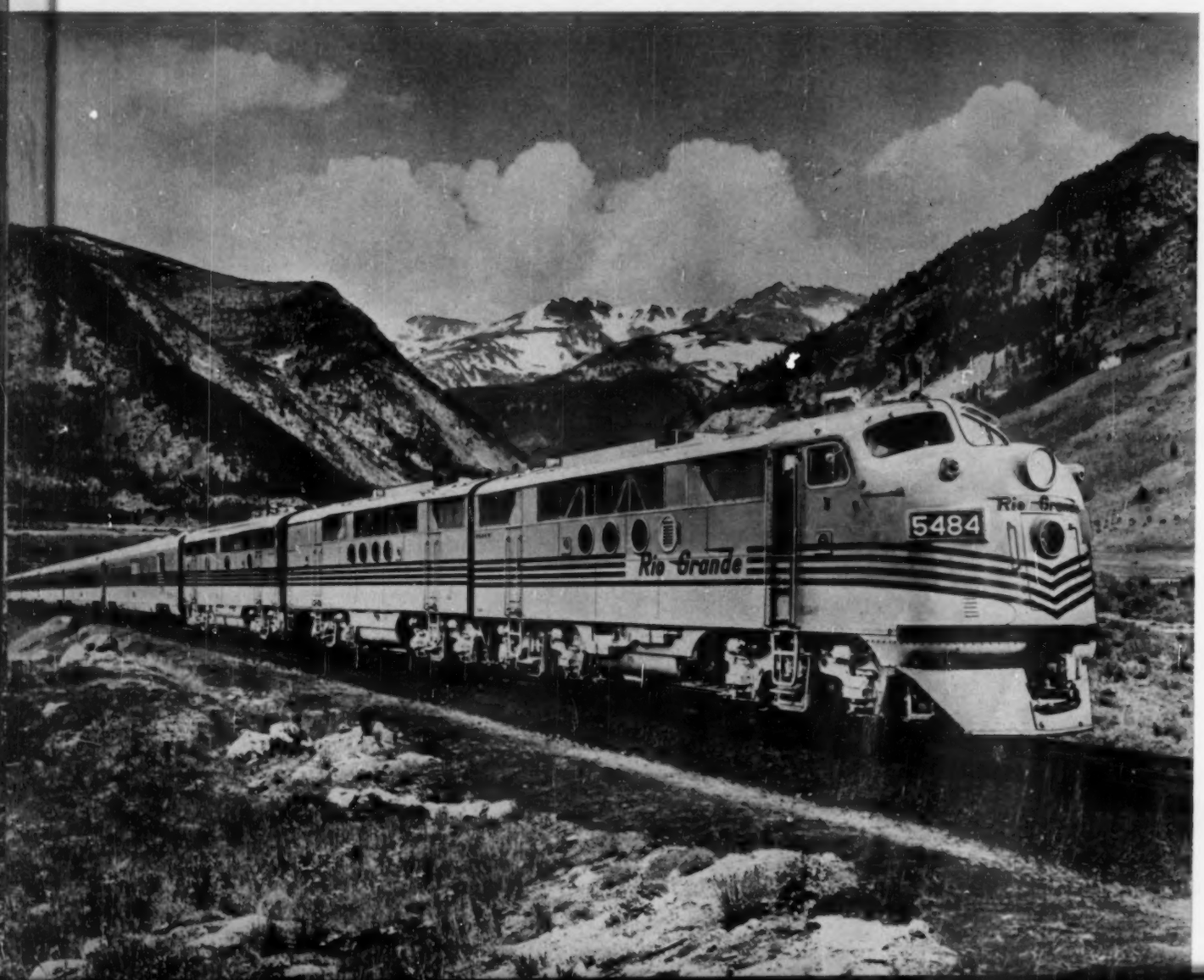
SHALE OIL FOR DIESELS

Colorado Shale Gives America Its Third Vast Source of Diesel Fuel Oil Supply

By CHARLES F. A. MANN

A TOPSY-TURVEY world of war, inflation and regimentation scarcely paused to take note that right in the heart of America, September 1, a third great and almost inexhaustable supply of fuel for internal combustion engines had opened up, and that the economics and technology involved, right down to costs per gallon, had gone beyond the test tube and become workable fact. A year ago the U. S. Bureau of Mines had successfully completed a project in the midwest to successfully produce diesel fuel oil from coal, and the Burlington railroad tested it on one of their diesel trains. Now, a second great project to augment America's fuel supply stemming from the 1944 Synthetic Liquid Fuels Act passed by Congress when conditions arising from World War II made it imperative that America might suddenly find its imported petroleum supplies cut off by submarines and aircraft, came to a happy conclusion when the Rio Grande railroad's *Prospector* made its fast 575-mile Salt Lake-Denver run powered with 2,450 gallons of diesel fuel made from Colorado shale at the Bureau of Mines plant at Rifle, Colorado. A fitting climax to the 1950 Mining Congress in Salt Lake when the *Prospector*, loaded with top-ranking mining officials, bureau bigwigs and Rio Grande officialdom, pulled out 15 minutes late with 15 heavy cars behind a 4-unit EMD diesel, with not a drop of fuel in it from regular oil industry sources—but full tanks from the retorts and midget experimental refinery high on the cliffs above Rifle, that once was a gummy substance mixed with rock, known as Kerogen.

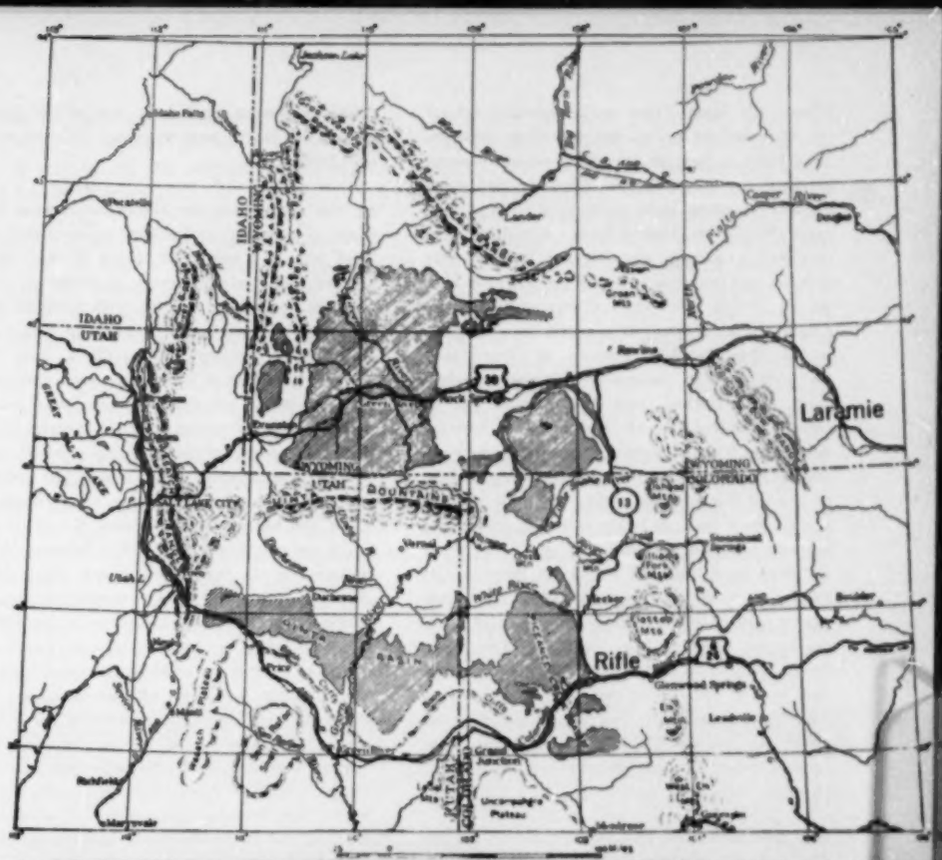
The western Colorado part of the Green River shale beds contains a 500-foot thick layer that averages about 15 gallons of shale oil per ton. Some 300 billion barrels can be recovered, or more petroleum than has been removed from America's oil wells since Col. Drake's little well started it all! The lower 70 feet of this 500-foot strata is known as the Mahogany Ledge, and is twice as rich as



the rest, yielding about 30 gallons per ton, and a known reserve of 100 billion barrels of shale petroleum. After endless research and surveys, the Rifle demonstration plant was set up to proceed to make liquid fuels for automobiles, jet planes, ship's boilers and diesels, as cheaply as possible, with the long-range view of getting the pioneering and research down to economic levels for the existing U. S. oil industry to take over. Thus it becomes more than a mining research venture, but a great national insurance policy on our power industry, and it is with this thought in mind that the bureau has delved into the job with cost-cutting at the mines going hand in hand with low-cost recovery of raw oil from the rock and refinery practices that will produce products that will work with today's diesel and gasoline engines. Hence the Denver and Rio Grande's successful use of the first diesel fuel oil ever made from shale becomes a milestone in American mining, oil and railroad progress. A sort of diesel shale oil progress.

At the bottom of the Colorado canyon below the bureau's workings, at the elevation of 5,173 feet, is a pumping station that lifts water clear to the mine yard at 8,200 feet elevation. The Rio Grande and a paved highway supply transportation. Mother Nature, when she made this part of Colorado, obviously had this site in mind, for the vast cirques in the cliffs below the mine can withstand rock dumping from a 10,000-barrel shale oil refinery for hundreds of years without filling up or costing a penny for removal. Every economic advantage of locating the mine as high as possible and stairstep downward all rock and oil handling, including spent crushed rock from the retorts, has been thoughtfully planned to reduce costs and keep the enterprise from being attacked by competition as unworkable or uneconomic. A lot of things will work, but at what total cost?

Mining itself is a complex experiment with use of manpower and machinery and labor to beautiful advantage. Great caves 60 feet wide and 27 feet high are the rule in this mine, leaving 60 feet square pillars for roof support—another astounding innovation to reduce the necessity of costly mine props and low-altitude machinery. A crew of 11 men turn out 1,700 tons of shale each 8-hour shift and now costs are down to 29 cents per ton at the mine. Every part of the operations are as highly mechanized as possible, to reduce costs. Instead of dragging air and water lines long distances underground, a unique portable utility station was developed, whereby two 770-cfm. air compressors and a 2,500-gallon water tank were mounted on a 30x12-foot rubber tired trailer of 50 tons capacity, fed by an electric cable from



Top Right: U. S. Geological Survey map of Green River oil-shale formations of Colorado, Utah, and Wyoming.

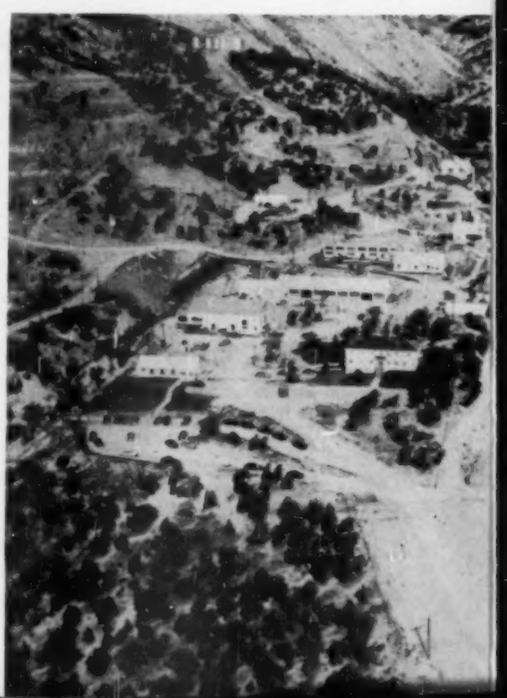
Shale oil powered Rio Grande's crack night Salt Lake-Denver train, *Prospector*, with bigwigs cluttering up the place: At controls, Dr. James Boyd, Director of U. S. Bureau of Mines, Washington, D.C.; in door, A. E. Perlman, General Manager, DRGW Railroad; on steps, Boyd Guthrie, Chief, Oil Shale Demonstration plant, Rifle, Colorado. On ground, left to right: K. L. Moriarty, Chief Engineer, DRGW Railroad; Dr. L. E. Young, President of American Institute of Mining and Metallurgical Engineers, Pittsburgh, Pa.; Emery Sipprelle, Chief Oil Shale Mining Branch, Rifle, Colorado.

outside the mine. This moves forward behind the drills and the heated compressed air, plus the usual losses in long air lines from outside stations, greatly raises the compressor efficiency, and paves the way for adoption in many other types of mining activity in the United States. A multiple drill carriage, or Jumbo, was designed to drill four holes at once with but two men, reducing the time for 72 15-foot holes from 10-man shifts to two 6-hour shifts. Blasting is speeded by a Wagner-mobile Duo-Way Life machine to elevate men and explosives to various heights for charging. Built like a forked truck, the machine can be tilted hydraulically in all directions. An International TD 6 diesel tractor carries a superior revolving crane, working on a pantograph principle, to provide fast access in scaling the mine walls to remove loose rock. A larger unit with telescoping elevator platform for scaling up to 65 feet above the floor level has been added. A Bucyrus Erie 54 B electric shovel, equipped with a 3-yard dipper, is used to load the three 15-ton Euclid diesel trucks for hauling shale from the mine. Last novel machine to be developed up to the workable level of cost cutting and speeding production with limited manpower, is the unique multiple rotary drill, borrowed in principle from those used in coal mines, but greatly modified for working in shale.

The day the bureau opened the mine to Mining Congress visitors, after the test train run, the new hydraulic rotary drill went into full operation. With hollow rods, bits tipped with Tungsten Carbide, ate through the shale at the rate of 100 inches per minute for a 2-inch blasting hole. The entire rig is mounted on a caterpillar tread tractor unit, and with telescopic hoisting leverage and a pushbutton control system, one man stands beside it on the ground while his 2-inch rotary drill eats away 8 feet of solid rock per minute, 10 feet above his head. Far down the mountain, some 2,000-foot vertical drop, the mined shale rock is run through two crushers and is ready to run through the batch retort or in the new small experimental continuous retort, for converting the trapped Kerogen into liquid shale oil by heat. After which the spent shale is dumped over the cliff as waste. The great objective in every step of the way is to test every step until it fits into the workable pattern of making the cost of synthetic diesel fuel oils come down to quickly meet the constantly ascending cost of diesel fuel from petroleum. Some say that the two will meet head-on in 1951. It may be just that close. Throughout the whole bureau operations at Rifle, every diesel uses fuel made from shale, which further widens the testing range and develops workable facts on petroleum vs. shale diesel fuel oil. Trucks, bulldozers, hoists, drills, etc., at Rifle, using shale oil, despite higher sulphur content, report actually greater efficiency than with petroleum fuels. Cooperating in the whole refining picture are the Standard Oil Development Company and Union Oil of California, which check on each others results, toward the common goal that Rifle may set the national pattern for a not-far-off commercial shale oil indusry of at least 10,000 barrels daily capacity. More than 65 outside groups are cooperating with the Rifle operation, such as colleges, chemical concerns, research and manufacturing companies, toward the end of full utilization of this far-reaching newcomer into the American fuel picture.

So, that shale from the highly mechanized Rifle mine, now being turned out on a shovel and truck basis at a mine cost of but 29 cents and a "loaded cost" including taxes, depreciation, insurance, etc., of 58.5 cents, may, with downhill gravity conveyor belts, larger shovels and bigger and faster drill carriages, drop down from 148 tons per man-shift of 8 hours, to something lower than one-half or one-third man-shift hours for the same quantity of mined shale. Retorting by the slow Batch system is the next step after the shale is crushed to ½-inch size. To start the program and get shale oil in quantities large enough to refine, the bureau has two 40-ton N.T.U. retorts, which operate similarly to a blast furnace. A fire is started at the top, by oil or gas, and a rotary blower forces the hot gases downward through the crushed shale. At temperatures of about 800°F., the shale below the burning zone is heated sufficiently to convert the solid Kerogen into shale oil vapors, which are drawn off and condensed into crude shale oil. About 3 per cent of the shale is left on the surface after the Kerogen has been converted to oil, which furnishes sufficient heat for the downward-traveling fire bed. After the fire reaches the bottom, the spent rock is dumped over the cliff below the retort and the process is started all over again. A dozen other processes can be used, many of which were first developed in Europe, including the Standard Oil's fluid flow and Union Oil's retort, both of which generate by-product gas and recycle the heat to reduce costs. The bureau's Rifle plant is now at work testing the continuous type retort on a small scale to further increase oil yield from the solid Kerogen. Costs are now set at about $1.50 per barrel for crude shale oil at the retort, but before going into a refinery, for a 10,000-barrel daily capacity plant. If it were possible to supply this crude shale oil to existing refineries, it would be possible to commercially market it in today's price structure, but the catch lies in the fact that the distances to other oil fields and the difference in refining methods between the two types of crude oil, make it necessary to keep on and refine it right at the mine. So, if the Rifle demonstration plant evolved into a 10,000-barrel-a-day commercial refinery, using thermal cracking and hydrogenation, 10,000 barrels of crude shale oil would yield under present methods 5,150 barrels of jet plane fuel, 3,350 barrels of diesel fuel, 340 barrels of fuel oil, 27 tons of ammonia and about 60 tons of coke each day, plus an unknown added list of by-products, at a net cost of about $1.40 per barrel. This, plus the $1.50 cost of the crude shale oil, gives a cost of $2.90 gross cost of an output that would sell for an average of $3.30 per barrel on today's market. Beyond today's estimate of total recovery from shale oil is the possibility of converting the surplus refinery gases back into more barrels of synthesized fuels and chemicals, with added market values beyond what is now foreseeable. Shale oil will never be a source of lubricants, for Nature arranged the molecules in the solid Kerogen so they wouldn't be refined that way. And no foreseeable use for spent shale rock from the retorts. But some day, Yankee in-

Considerable blasting and bulldozing were required to make this shelf on which the mine buildings are located. To the left of the buildings are two portals which are entries to the underground quarry, the upper portal being the entry to the top level or advance headings, and the lower portal being the entry to the lower level where the benching operation is carried on. The buildings, left to right, are the two-story combined office and warehouse building, the change house, and the building housing the shop and compressor facilities. To the right of the shop building is the portal to the haulage adit of the selective mine where various grades of shale are mined selectively for experimental crushing and retorting operations.



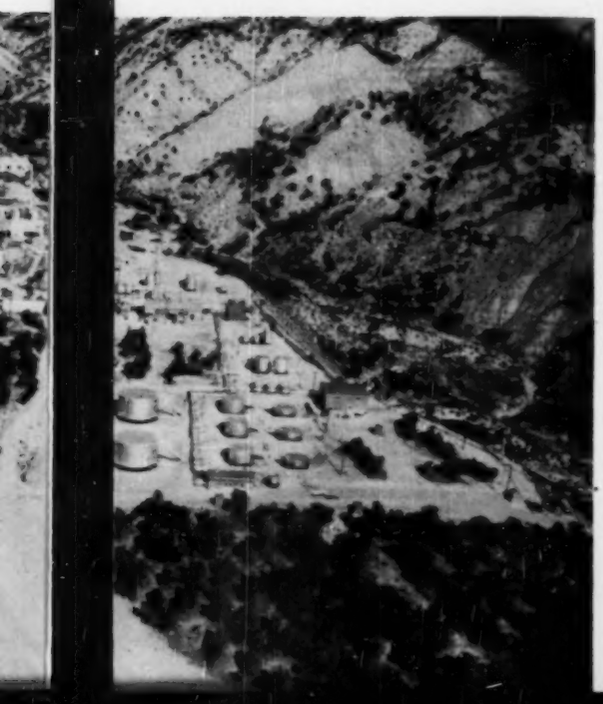
genuity might make something of this toasted rock—since its original base was a sort of Magnesium marl—which the chemical people might turn into Magnesium metal.

Geographic features of this mighty mountain of shale, with its billions of barrels of recoverable oil, plus the ominous clouds of another World War, may suddenly bring America's economic machinery to suddenly open a hundred mines like now are operating at Rifle. A 15-foot cube of the Mahogany Ledge, weighing 208 tons, refines down into 6,250 gallons of crude shale oil; 2,200 gallons of heavy fuel oil; 1,250 gallons of gasoline; 1,250 gallons of diesel fuel and 2½ tons of coke. The diesel fuel will fill one tank on a 1,500-hp. EMD diesel locomotive unit. A 3-inch cube of the Mahogany Ledge will fill a Seven-up bottle full of crude shale oil. A ton of Mahogany Ledge shale will fill a 31-gallon barrel within ½-inch of the top. A single shale miner at Rifle can produce a 15-foot cube of mined shale all ready for the primary crusher in about 10½ hours working time. Already throughout the United States there are many places where diesel fuel costs far more than $3.30 per barrel right now in 1950 (the estimated cost per barrel from shale today). The railroads that feed to and from the Rio Grande, today, could almost use the diesel fuel output of a 10,000-barrel daily plant at Rifle . . . and so on till diesel users throughout the United States will begin sitting up nights with the rosy dreams and far-visions conjured up by the great new U. S. fuel oil industry now a-borning in the heart of America, in the dry, sunny air of the upper Colorado River . . . America will never run out of diesel fuel oil.

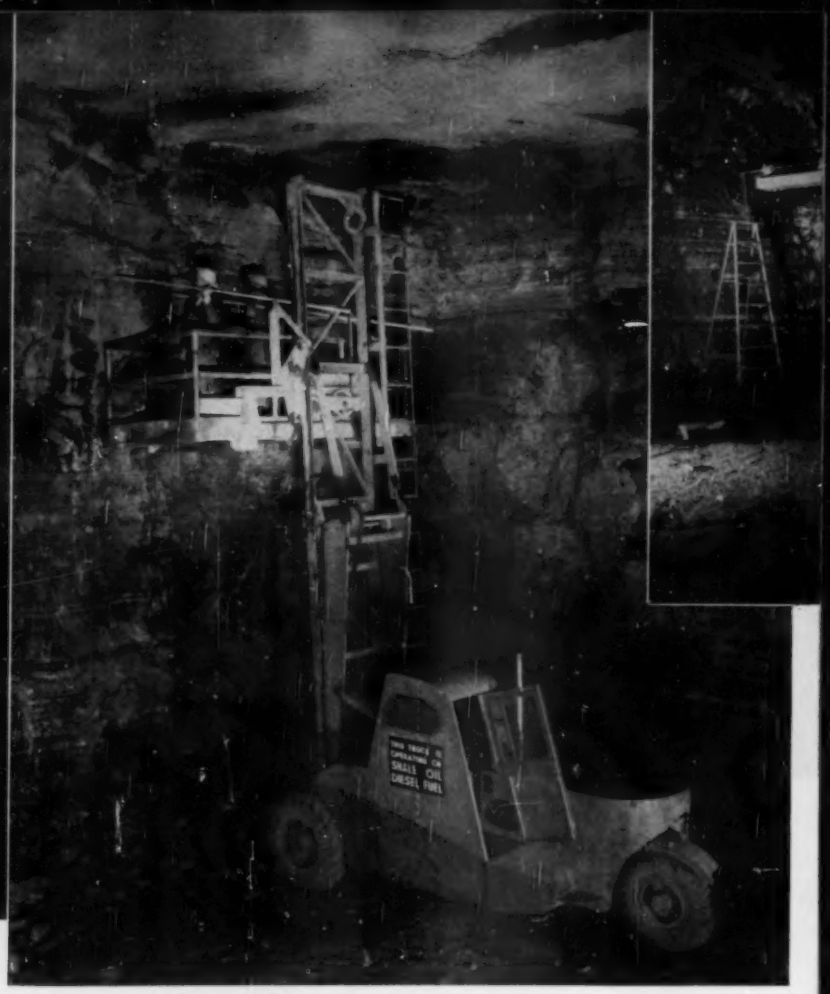
So, on the hot September night when the big 4-unit EMD diesel locomotive pulled out of Salt Lake with a solid carload of America's top mining and oil bigwigs aboard, everybody watched to see if she smoked too much or faltered. Fifteen minutes later everybody, including Engineer J. S. King, up in the cab, forgot there was shale oil in the tanks. With added cars, and two heavy cars substituted for ordinarily used light weight new cars because of their air conditioning failure at

To the left is the 5½-mile zigzag road leading from the plant area to the mine. In the lower center is the 70-unit housing area and a portion of the access road leading from highway 6-24, and the plant area to the right.

In the upper part of this area is the shale-processing equipment. To the right and farther down the hillside is the refinery, and to the left are the steam-generating plant, pilot plant, laboratory, shop buildings, and office building.



The mine is 60 feet high. Highest of its kind in the world. In the foreground — Euclid dump truck, 15 tons, with Cummins diesels. Top — Vertical jumbo driller mounted on Allis-Chalmers tractor powered with General Motors diesel. Center — Bucyrus-Erie electric shovel. All photographs used in this article through the courtesy of the Bureau of Mines, United States Department of the Interior.

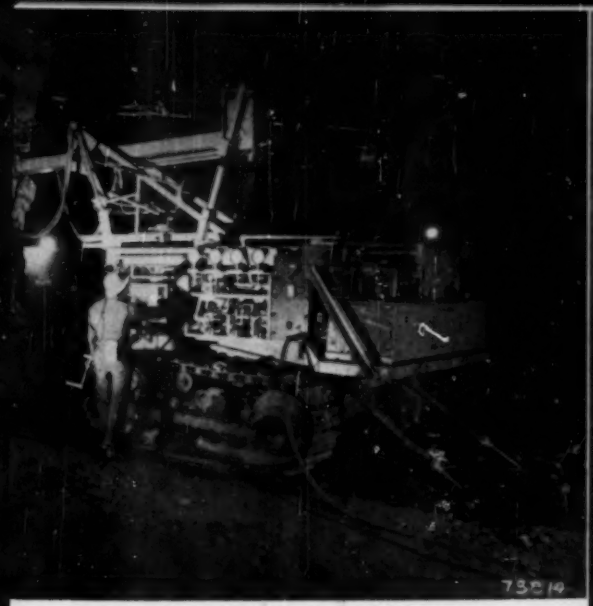


Blasters' platform elevates men into position for charging explosives into horizontal blast holes. This piece of equipment invented for this particular job.

the last minute, the 15-car train pulled by EMD units 5544, 5542, 5541, all F-3 EMD units geared to 75 miles speed, and 5573, an E-7 unit, romped easily to Provo, at the foot of the long climb through the Wasatch Range. One steam generator was operated continuously all the way from Salt Lake to Denver and the second steam generator about 40 per cent of the total time. For the 50-mile climb to Soldier Summit, nearly 3,000 feet higher, the diesels were run wide open to make the fast schedule on this extra heavy train of nearly 1,400 tons. Normally, a 3-unit diesel with 8 to 10 cars makes the fast time without difficulty. The warm night and the new fuel and added unit gave the engineers a slightly jittery feeling, not to mention added inward caution when considering the Guinea pig nature of the run. At Salt Lake the four tanks were drained of regular fuel and completely filled with 4,800 gallons of shale diesel fuel. Measurements were taken at Grand Junction and Denver to check consumption, and 2,450 gallons were used on the trip of 570 miles, or an average of .39 gallons per passenger car mile, equated for dropping off cars at Grand Junction and Rifle. Injector racks on the diesels, as well as load regulators, were carried at the same position as normally with regular fuel oil. Out on the road after delays leaving Salt Lake and losing a few minutes on the heaviest grades, wherever operating conditions permitted, the train made up time. Out in the western Colorado desert at one time we were barely 20 minues late, and everything seemed lovely until the hot engine alarm bell in No. 1 unit started ringing and refused to stop. A quickie checkup revealed no hot engine anywhere. Finally, at Westwater, Colorado, No. 1 diesel went out of commission entirely, so luckily, with the last adverse grades behind, the 3-unit plus 1 dead unit, rolled up to Grand Junction at better than 70 mph. At Grand Junction, 8 cars were cut off to run to Pueblo as part of the old Scenic Limited, and in the dead of night another sleeper cut off at Rifle, leaving 6 cars to reach Denver next morning about one-half hour off schedule due to the need of taking the dead unit to the Denver shops. The trouble? A broken fuel oil pump in No. 1 unit. No better illustration of the advantage of multiple unit diesel operation can be had than this. Twenty-five per cent of a diesel locomotive out of commission, yet the train runs practically on time into the home terminal while carrying the dead unit piggy-back style. It was noted that immediately following a change of throttle upward, that there was quite a lot of exhaust smoke, but within 5 or 6 seconds, while the diesels were getting up speed, the exhaust would clear and the diesels would run perfectly smooth.

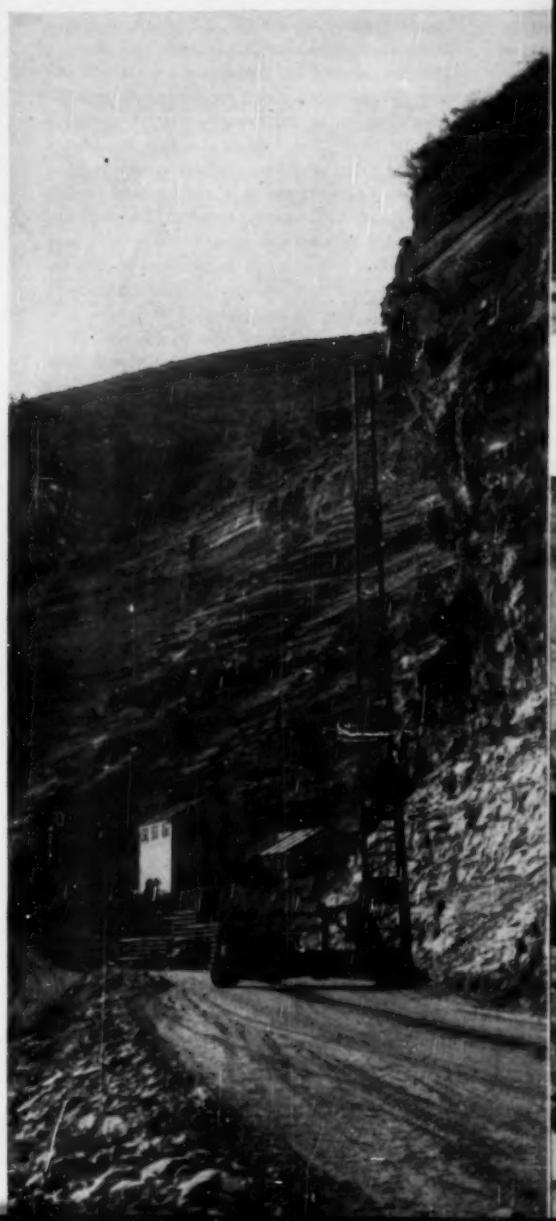
Rio Grande specializes in one type of road diesel, the EMD 8-wheel F-type unit, with different gear ratios for different service. This gives a locomotive with ideal wheelbase and pulling power for the stiff mountain grades and curvature, yet ample speed for the wide open stretches. Only the new *California Zephyr* has the 6-wheel trucks and dual diesel units. The company had as of January 1, twelve 5,400-hp. freight diesels, 3-4 unit F-3 6,000-hp. general purpose road diesels, 10 F-7 all-purpose 4-unit, 6,000-hp. diesels and two 6,000-hp. Alco passenger locomotives. Any or all of these units will, frequently, be run in tests on various types of Rifle shale diesel fuel.

A far-reaching program of cooperative research between the Bureau of Mines and the Rio Grande Railroad, involving staking out of mine and refinery sites of potential future use, water sources, freight rates on supplies and petroleum products, and myriads of other detail is underway with the industrial department of the Rio Grande, headed by C. M. Lightburn, all to pave the way for a possible sudden decision on the part of our far-flung U. S. defense mechanism to suddenly lift the demonstration plant at Rifle, headed by Director Boyd Guthrie and his crew of able, daring young engineers, and the Rio Grande Railroad's contributions, to shut off foreign dependency on petroleum and make this Continent self-sufficient, so that we can keep going intact, into whatever future is in store for us.



Rotary test drill used for experimental drilling on top level of the underground quarry. This is a hydraulic Allis-Chalmers—General Motors diesel unit.

65-foot telescopic scaling rig removing loose rock from a cliff. This unit invented for this purpose. Same unit is used inside mine to chip loose rock from roof.



Miners scaling loose rock from the mine walls, work from the platform of a boom-type scaling platform mounted on an International diesel tractor.

A 3-yard Bucyrus-Erie electric shovel loading oil shale into 15-ton, rear-dump diesel-powered Euclid dump trucks.

VALVE PROBLEMS IN DIESEL ENGINES

By VINCENT AYERS*

This Paper Was Presented at the SAE Summer Meeting, June 4-9, 1950

YOU have heard the statement that the problems of fuels, lubricants, and engines are inseparable and the valve gear is one part of the engine which is definitely included in this statement. This paper is intended primarily to cover the valve problems; therefore, the design of the valve gear will be discussed as it affects the valve.

The definition of a valve problem is any function of design, operation or maintenance resulting in premature failure of the valve, or impaired engine operation. The problems with which we have been confronted in diesel engines might be listed in their order of importance as follows:

(1) Breakage.
(2) Seat wear.
(3) Valve face guttering.
(4) Stem and guide wear.
(5) Sticking.

These problems will be presented and possible solutions suggested for the benefit of the engine manufacturer so that he may have aid in analyzing his problem and so that the operator and maintenance crew can appreciate why it is necessary to perform certain maintenance operations which might seem difficult or expensive.

VALVE BREAKAGE

A valve breakage can be disastrous if it completely wrecks an engine; and after the failure has occurred, it is difficult to determine the cause.

One sequence of events occurred when a valve broke and went through the top of a piston. The piston jammed and broke the crankshaft which, in turn, punched out the side of the crankcase. The engine was locked in gear and, with the help of the truck driver's foot on the brakes, the rig was stopped. In the process, a load of steel on the second trailer broke loose, severed the trailer hitch and went into the pavement with enough impact that the shock was felt in the company's money box when the city's repair bill was received.

Valve breakages can result from improper installation as well as borderline designs. Improper installations are difficult to trace unless repeated, but borderline designs can be traced since the failures are usually of the fatigue type. Fatigue breakages may occur at several locations on the valve depending upon design, and we might consider the causes that will lead to this form of destruction.

These are: (1) abnormal loading of the valve, or (2) a design which lends itself more readily to fatigue failures. Abnormal loading can result from overspeeding the engine, or may be present after wear has occurred in valve train parts, increasing lash. The manufacturer designs a valve train for a given set of operating conditions but engines differ in their ability to operate well when these conditions are varied.

Overspeeding, while not common in diesel engines, can occur if the engine is used in a vehicle, especially downhill, or if the operator adjusts the engine so that higher speeds may be obtained. One known case was that of an operator who found he could move a much heavier load if the engine was operated 200 rpm. higher than normal, but the engine broke valves when operated at this higher speed.

Manufacturers are charged with the responsibility for designing valve trains with a factor of safety for overspeed. To design a valve train for higher speeds it is necessary to consider more than just the structure of the valve even though the valve might be the weakest member of the valve train. An improved valve in this instance may result in a slight increase in life before the breakage occurs at some point on the valve or in the valve train.

One remedy which has resulted in raising the normal operating speeds of engines successfully is to improve the valve motion. A study of the valve train deflections will uncover any weaknesses in the system. Such a weakness may be found in the push-rod, rocker arm, rocker shaft or rocker shaft support. If the thought is kept in mind that rigidity is more important than weight in diesel valve trains, the next step can be approached.

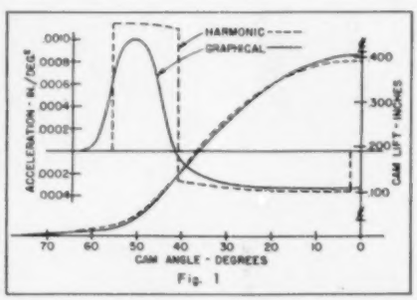


Fig. 1

That is, redesigning cam contour for the purpose of eliminating excessively rapid changes of acceleration which are kin to impact. Turkish[1] in his valve gear design treatise discusses a semi-graphical method of cam design. Through the use of this method, a slightly modified lift curve designed with an eye on the acceleration diagram can reduce theoretical impact values from infinity to values which the valve train can withstand without undue deflection and vibration. This type of cam design is now common in automotive gasoline engine[2] and is gaining in its use in diesels.

Figure 1 shows typical lift and acceleration diagrams for graphical and harmonic cam designs. The designs used for illustration are the old and new provided on a diesel engine having approximately 200 cu. in. displacement per cyl. operating at 1200 rpm. The harmonic design included a dwell of 5 deg. at the nose joined by nose radii of .130 in. The acceleration of the harmonic design was typical with square corners. Theoretically, this design requires the gear to change from zero acceleration to maximum acceleration in zero degrees. Force is equal to mass times the acceleration and if the later is changed at a very high rate, then the force is changed also at this rate. This is known as impact, and in a valve gear is actually a blow which starts the gear vibrating. This vibration will have amplitude, frequency, and rate of decay proportional to the striking force, stiffness, and damping characteristics of the system. It is not uncommon to have this vibration exist all through the lift cycle and cause high valve seating impact with possible breakage.

Since the cam determines the motion it can be made to push instead of strike the valve gear. The graphic design shown requires approximately 10 deg. cam travel to change from zero to maximum acceleration and pick up a load of 250 lbs. A higher maximum acceleration is possible with this type of contour because the rate of load application is low, but a lower acceleration was used in this instance. The cam angle is wider but the lift curve is only slightly affected. By eliminating the dwell and increasing the nose radius to .222 in. the lift was increased and the tappet stress reduced.

Measurement of actual loads in the valve train through the use of a resistance wire strain gauge on the rocker arm or push-rod is recommended as a means of comparing designs. Abrupt changes of load are easily detected and improvements in cam design will evidence themselves by a smoother loading diagram more closely approaching the theoretical and in freedom from extreme changes

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of load value. Other benefits may be reduced valve spring load requirements, reduced spring vibration and breakage, larger cam nose radii, all of which reduce tappet face stresses; reduced camshaft torques which benefit timing gear life; and less valve train noise through the speed range.

Wear in the valve train parts may contribute to breakage if the velocity of valve seating is increased. Minor effects are seat wear and dishing of the valve. I refer here to wear which might occur on the tappet face, cam lobe, rocker arm, valve tip, or valve guide. In computing required ramp heights for cam designs, consideration is given to lash and the amount of ramp required to compensate for maximum cocking of the valve[1], but if these values are increased through wear, then the designed ramp height becomes inadequate to control valve seating. The use of hydraulic lifters as a means of lash control has been accepted by the industry, and in conjunction with improved cams, has contributed toward reduced valve breakages.

VALVE STRUCTURE

A study of successful valve designs will disclose some common features, and departures from these tenets might show up as valve weakness.

The valve head section should be rigid enough to support the gas load without undue deflection. Mass of the valve head may not be the complete answer since the strength of the valve material at the operating temperature is also involved.

The valve rim should not be too thin because a thin section will have a greater temperature fluctuation leading to a thermal fatigue evidenced by cracking, splitting, or curling.

A decently wide seat contact is good practice with as little of the valve head as possible extending beyond the seat into the combustion chamber. A large portion of the valve heat is carried through this contact.

A generous underhead radius with no abrupt changes in section at the junction of the head and stem will reduce the concentration of stresses in this area. Fatigue failures in this area are seldom eliminated by adding large masses of steel. Much more can be gained by eliminating the cause of the high loading, using a higher strength material, and lowering valve temperature.

Valve guide length and position have an effect on valve temperatures and motion. A guide length of not less than 50 per cent of the total valve length, evenly spaced, is a good rule of thumb. Most engines have guides longer than this. Lowest valve temperatures in the critical area beneath the head are obtained when the guide boss and cooling water jacket are brought close to the valve head. Port cross-sections may become unsymmetrical and casting difficulty experienced, but results are worth a good try.

A lock ring in a groove on the valve stem can prevent a valve falling into the combustion chamber

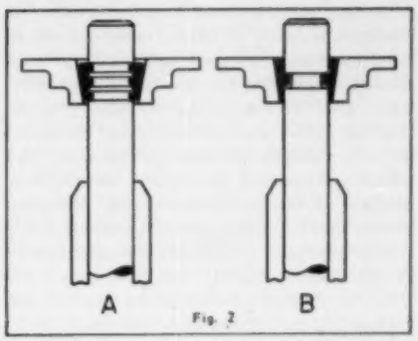

Fig. 2

if the valve spring breaks. Damage to the engine can still result, however, if valve to piston clearances are close. Bending loads, resulting from out-of-square springs or other causes, concentrate stresses in the lock ring groove and valve stem fatigue failures at this point may disappear with the elimination of the groove. After all, valve springs should also be designed so that they do not break.

On the other hand, the breakage then may be transferred to the valve keeper groove. Keeper designs of the double or triple bead type, Fig. 2a, will concentrate these same bending loads in the first groove toward the guide. I cannot recall ever seeing a failure on one of these designs which occurred in the second or third groove. A design which grips the valve so that the bending loads are taken on the full diameter, Fig. 2b, will greatly increase the life, or cause the failure to occur in some other place.

Another possibility is a design which allows the spring retainer washer to equalize the load by tilting on the valve stem. This precludes the use of wedge type keys which lock and instead introduces relative movement with its hazards of wear.

VALVE MATERIALS

Valve materials may be selected on the basis of (a) strength at the operating temperature, (b) hardness at the operating temperature, and (c) resistance to environment. The choosing of valve steels should not be considered as a mysterious activity, but is sometimes placed in this category due to the mystery surrounding the item of valve operating temperature. Testing to determine actual valve operating temperatures is not extremely difficult and values within 50 deg. are obtainable[2]. I refer here to the property of hardness loss with temperature of certain steels. A valve steel such as silcrome No. 1 can be fully hardened to approximately 58 Rockwell 'C' and it will lose hardness when subjected to temperatures above 900 deg. F. The hardness will be in the neighborhood of 20 Rockwell 'C' when a temperature of 1550 deg. F. is reached, and in between these points a 100 deg. variation will change hardness about four points.

While this method may seem crude to exacting scientists, it is accurate enough to serve as a comparative test to determine the benefit of any design changes in lowering temperature. Surely if such changes will not show up in this test they cannot be expected to produce extended valve life.

Valve temperatures might be divided into zones and classed as cool, temperate, and hot. Cool meaning below 1200 deg. F., temperate being the range of 1200-1400 deg. F., hot being above.

Classification makes the selection of valve steels, on the basis of hot strength or fatigue resistance, relatively simple. All of the commonly used valve steels have good strength in the cool zone, and none of them have good properties at temperatures above 1450 deg. F. The reason for sodium-cooling any valve, gasoline or diesel, is to drop its temperature into the temperate zone or lower. Steels to operate in the cool zone are chosen with regard to ability to resist environment (corrosive or oxidizing atmosphere) and for economy. Inlet valves, and a few exhaust valves, are in this group.

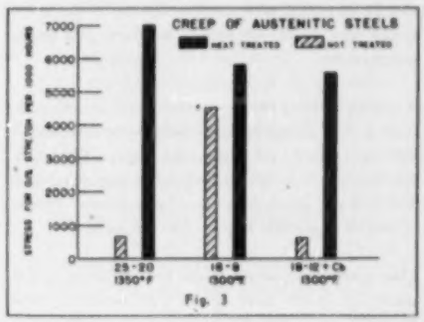

Fig. 3

Engine builders already know that austenitic steels have better strength properties than hardenable steels in the temperate zone. Proof is in the fact that the majority of diesel exhaust valves are made of austenitics. A common belief is that, since these materials cannot be hardened by heat treatment, then there is no point in heat treating. Hot strength, however, can be improved as illustrated in a comparison of creep tests on austenitic steel alloys with and without heat treatment. Fig. 3 shows the gain in creep resistance of several austenitic steels in the temperate zone. While the tests charted are not on valve steels, the comparative improvement is evident by the increase in stress required for 0.1 per cent stretch in 1000 hr. Austenitic valve steels show response to heat treatment in similar manner, but a stepped up method of testing has been used to reduce test time without affecting results.

Figure 4 illustrates the improvement of hot stretch resistance resulting from heat treatments applied to austenitic valve steels. The validity of this test method has been checked by comparing engine valves of the materials shown with and without heat treatment. The use of nitrogen bearing 21-12 has reduced dishing and breakage and that is why it is being specified for many engines.

Hardness of austenitic steels cannot be increased to any marked degree with heat treatment, but it may be reduced by the same heat treatments that improve hot strength which indicates that a balance of desired properties must be sought.

The severity of this test is too great for steels of the hardenable or semi-austenitic types, such as silcrome No. 1, silcrome x-be, or xcr, for these materials will stretch, dish or break in some en-

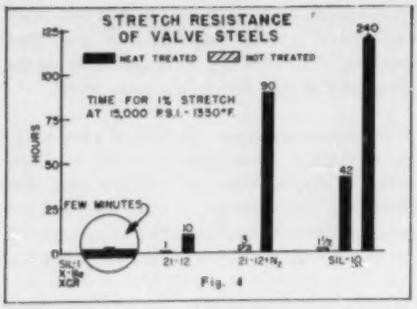

Fig. 4

gine operating conditions where the austenitics will not, thus further attesting to the validity of such a test. Fig. 4 shows the time for these steels as only a few minutes since they start stretching as soon as the load is applied. Reliable figures can be obtained with these materials if the stress is cut way down, or if they are run at a lower temperature.

A milder form of the problem of breakage, namely, lack of hot strength, may show up as dishing of the valve head rather than breakage. This dishing may result in loss of lash and subsequent valve seat leakage which raises the temperature. Proper choice of materials here is also essential.

One other point which might bear mention is that austenitic steels have lower coefficients of heat transfer and higher coefficients of expansion which must be considered in the engine design.

SEAT WEAR

The problem of seat wear in diesel engines has been present for many years with the greatest number of failures occurring on the inlet side. There are two possible explanations for this occurrence; one being that there may be different materials in the two ports because of the necessity of using a better steel on the exhaust for other reasons. This better material can either be a high alloy exhaust valve steel or some other corrosion-resistant alloy such as Stellite or Eatonite which may also have a property of abrasion resistance better than the inlet valve.

The other possibility is that the exhaust valve is coated with deposits resulting from combustion which act as an insulating layer and prevent intimate contact between the exhaust valve face and the cylinder head seat.

The deposits seem to be most significant since it is a known fact that materials to be rubbed together without lubrication must be selected for this property. Most of the inlet wear, unless caused by dirt, occurs not on the valve but on the seat in the cylinder head and might be called fretting, scuffing, or microscopic welding. The rate of wear in some cases has been known to be as high as .001 in. per hour. Peculiarly, the wear may not occur on all valves in the cylinder head, and some cylinder heads may have an extreme amount of wear on one valve with none on another. This, apparently, is not a function, then, of metallurgical differences from one cylinder to another, but is more an operating difference, such as the amount of relative distortion from one port to another and one cylinder head to another. If distortion is found to be the cause, the use of other materials or a change in the cylinder head sections surrounding the valve might result in reduced wear. That this is true is evidenced by the fact that some manufacturers have eliminated wear by changing cylinder head structure, and others, unfortunately, have gotten into the wear problem by making such a change. Distortion creates wear by causing the valve to contact only a small portion of the cylinder seat when contact is first made at seating. The valve then either slides or is forced by cylinder pressure into full contact provided, of course, the seat is still round. This small movement at high pressure is the start of fretting or roughening of the valve or seat. It is aggravated by poor valve motion and bad mechanical conditions which allow misalignment. A change of seat angle may give relief; for example, if distortion is lateral, a 15 deg. seat angle valve would be unseated much less than a 45 deg. valve.

The use of a different material combination has to date been the most positive means of reducing wear. Its effectiveness has not been 100 per cent and what works in one engine may not work in another. The choice of materials is limited to cast iron for the seat, unless the manufacturer resorts to the use of a seat insert, and the valve materials. Considerable testing is involved in choosing the right combination and the medicine may be bitter from the standpoint of cost.

Some valves have shown reduced wear of the valve face or cylinder seat face when allowed to rotate; others have shown more wear. Rotation should be noted in conjunction with this problem and, if beneficial, incorporated.

The use of coatings on the face of the valve or cylinder head seat remains to be exploited. I refer to such things as tinning which is done sometimes on other engine parts to eliminate scuffing. Hardening of the cylinder head iron has shown benefit, but high valve hardness has not been very effective since the greater amount of wear is usually on the cylinder head, particularly if no insert is used.

The direct aplication of stellite on the cylinder head is sometimes a salvage measure and often improves life.

VALVE FACE GUTTERING

Valve face guttering, on the other hand, has been primarily an exhaust valve problem. It might be considered as having two phases; one being the result of distortion which allows leakage to occur in one local area, or as a result of bad mechanical conditions; and the other phase being the leakage which results when deposits which have formed between the valve and seat break away. Gasoline engines have long been subjected to the formation of deposits but the problem is relatively new for diesel engines. What the future holds cannot be predicted, but indications are that lubricating oils containing high quantities of additives will increase the amount of deposit formation on diesel engine valves and thereby aggravate the problem of seat leakage. Additives in the fuel could further complicate the picture. Improving life under both of these conditions which cause leakage can be based on experience gained in improving life in gasoline engines.

A valve material selected for its resistance to environment is indicated. Fig. 5 shows hot hardness values for various steels which are an indication of resistance to pitting by indentation or deformation which may lead to guttering. Temperatures of 950 deg. F. and 1300 deg. F. are used (4 and 5) and the data from mutual indentation are given as Brinell hardness. In the temperate zone the hard facing alloys, Stellite and Eatonite, are most useful. The same chart rates the scaling resistance

MATERIAL	HOT HARDNESS BRINELL		SCALING RESISTANCE Mg/200 hrs.	
	950°F.	1300°F.	OXIDIZING	REDUCING
CARBON OR LOW ALLOY	200	UNDER 40	ABOVE 20,000	
EXHAUST VALVE ALLOYS				
SIL-1	(250)	40	↑	↑
X-Be	254	40		
XCR	230	110	30	50
21-12	130-180	90-116	to	to
21-12+N_2	130-180	90-120	90	150
SIL-10	142	90	↓	↓
FACINGS				
STELLITE #6	(320)	(275)	LESS THAN 20	LESS THAN 15
EATONITE	(350)	(330)		

Fig. 5

of these materials[6], but for simplicity these are shown in thre groups; i.e., (a) carbon or low alloy steels whose loss in scaling is 20,000 Mg/200 hr. or greater; (b) valve steels with loss range of 30-150 Mg/200 hr.; and (c) Stellite and Eatonite with values less than 20 Mg/200 hr. The relative scaling resistance of carbon steels or standard low alloys like SAE-8645 and the valve steels helps to explain why the low alloys are being replaced as inlet materials.

Experience on a few tests with high ash oils indicates that guttering on valves and seats of both inlet and exhaust can be caused when small areas of deposits break off. The guttering is straight high temperature oxidation and not corrosion.

Diesel engineers use exhaust gas temperature as an indicator but do not realize that high-pressure, high-temperature leakage can create 1500 deg. valve temperatures without affecting exhaust gas temperature which might be as low as 800 deg. Thirty to 50 hr. of full output running (with a narrow leakage area) can cause bad guttering on valve steels, whereas upwards of 250 hr. are required with a hard facing under the same conditions.

Guttered valves, even when hard faced, are possible with present fuels and lubricants indicating that a close watch on temperatures is required. One valve returned to us for comment had a bright shiny appearance at the seat contact with a couple of guttered areas, but after electrolytic cleaning the gutters were no longer present. The steel showed practically no effect of the leakages and the deposit which formed the seating surface was entirely gone.

Here, again, rotation has proved of benefit in keeping temperatures, deposits, and leakage under control. The use of rotators in diesel engines is relatively new but the gains in valve life may well justify the expense of incorporating a device which will allow valve rotation.

STEM AND GUIDE WEAR

The problem of stem and guide wear is essentially no different than other problems of engine wear. It is a function of three things: (1) materials and hardness; (2) load; and (3) lubrication.

The use of special materials, heat treatments, coatings, etc., has shown some merit and several manufacturers are using valve guides which have been ferroxed or parco-lubrized with success.

Size and surface finish are also important and proper valve train geometry must not be overlooked. Information on these subjects is available elsewhere as indicated in the bibliography (1 and 7).

The most effective element in freedom from wear is adequate lubrication, assuming that the aforementioned factors are given recognition. Past experience has indicated that nearly any material combination will be successful, since the loads are light, if given a reasonable amount of lubrication; but very few materials will operate satisfactorily in a dry state. The problem becomes one of maintaining satisfactory lubrication on both exhaust and inlet valves without over-lubricating the inlet valve, and thereby increasing oil consumption or under-lubricating exhaust valves as a result of scanty oil supply or deposits. The use of an oil seal ring on the inlet valves, coupled with close stem-to-guide clearance, may effectively satisfy the inlet valve requirement, and an ample oil supply on the exhaust, with the minimum possible stem-to-guide clearance for effective control and improved heat transfer, may be the most satisfactory. Excessive stem-to-guide clearances hamper the transfer of heat from the valve to the cooling medium and allow room for deposits to form which reduce the effectiveness of lubrication.

STICKING

The problem of sticking has been placed at the end of the list since it might be classed more as a nuisance problem on diesel engines. Sticking results from building up of deposits on the valve stem, causing it to be sluggish in the guide or, in some cases, causing it actually to become wedged to the point of not operating. If the valve sticks in an open position it may be struck by the piston, resulting in engine damage. At this point it is more than a nuisance.

The problem may be approached from two directions: first, do not provide any space for deposits to form; that is, keep stem and guide clearances to a minimum. Any spaces that are available for deposits to form should be as wide as possible so that these deposits can reach their maximum normal thickness without obstructing the movement of the valve. An example is the use of counterbores in the valve guide which, if used, should be large enough to allow the deposits to build up and break off before they will wedge.

Better still, to reduce the guide length so that the point of first contact between the valve and guide occurs where the temperature is low enough not to cause breakdown of the oil to form deposits.

The use of oils which have reduced deposit tendencies is recommended, but the most effective elimination of valve stem sticking is the use of a device which allows the valve to rotate.

The use of solvents on valve stems to remove gummy formations has been tried successfully by some engine builders. One had a passage leading through the valve guide and cylinder head to the outer deck next to the valve spring and periodically a solvent was forced into this passage. Subsequent use of a release-type rotator showed such benefit that it was adopted in production.

SUMMARY

In summary, then, the causes of breakage are:

(1) High loading of valve resulting from—
- (a) wear in valve train
- (b) overspeeding
- (c) high lash
- (d) cam design not matched to valve gear
- (e) maintenance, cocked springs, out-of-round seats, etc.

(2) Valve weakness caused by—
- (a) design of valve structure
- (b) material inadequate at temperature.

The causes of seat wear are:
(1) incompatible materials
(2) high unit loading
(3) material inadequate at temperature

The causes of valve face guttering are:
(1) leakage resulting from out-of-roundness
(2) leakage resulting from deposits breaking away
(3) materials which will not withstand environment (temperature, atmosphere, indentation)

The causes of stem and guide wear are:
(1) poor geometry
(2) wrong materials, finishes, etc.
(3) poor lubrication

Sticking is caused by stem and guide deposits resulting from:
(1) too high a temperature for the oil
(2) scanty oil supply
(3) excessive stem-to-guide clearance

The remedy for these problems lies in recognizing which fundamental causes apply in a given case and making use of all available knowledge towards their elimination.

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THE NEW ELLIOTT TURBOCHARGER

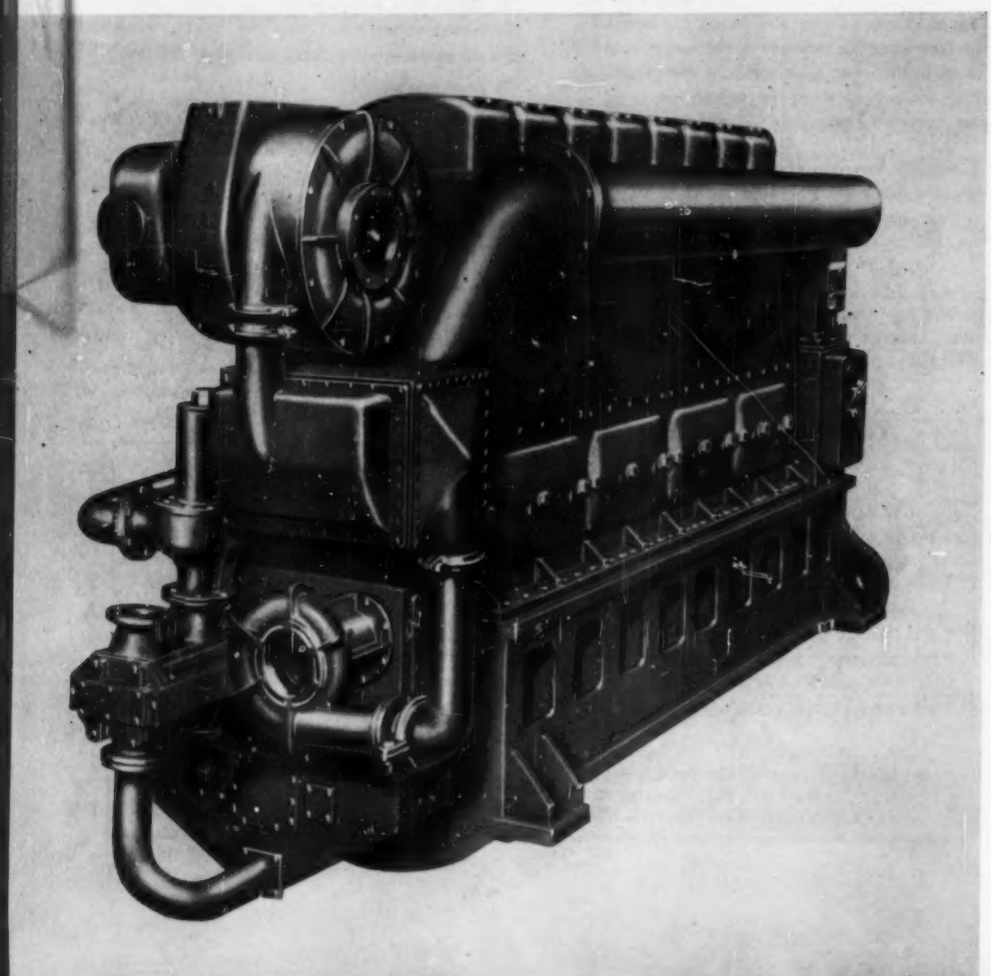
By WILBUR W. YOUNG

WITHOUT much fanfare, the Elliott Company recently announced a new line of turbochargers, based on its own design. This new line of turbochargers embodies certain design features and performance characteritsics which are of vital interest to diesel engine designers and operators and which fit hand-in-glove with the modern trend toward ever increasing engine outputs. The Elliott Company has been building tourbochargers since 1940 and has put out turbochargers on some 6,000,000 bhp. of engines These units have served to increase normally aspirated engine ratings up to 50 per cent and have given good account of themselves. Out of this long and satisfactory experience, this new design has been evolved.

Mechanically, the new Elliott turbocharger is of simplified design and rugged construction. The shaft is simple and strong with bearing support between the turbine and blower rotors. Taking full advantage of advances in precision casting of aluminum, the blower impeller is strong and of advanced aerodynamic design. The latest metallurgical developments have been employed in the materials comprising the turbine discs and buckets and throughout the line only buckets with broached pine-tree roots are used. The new line of turbochargers includes two types – high pressure and low pressure. Until its advent, turbocharging pressures were limited to approximately 7½ psi., corresponding to 120 b.m.e.p. But there has been a definite trend in modern engine design toward ever higher brake mean effective pressures and higher outputs per cylinder which, per se, called for higher turbocharge pressures. Consequently, the Elliott high-pressure turbochargers, a full range of which are offered in this new line, develop 18 to 20 psi. blower discharge pressure permitting 200 b.m.e.p. Both types of these new turbochargers are being manufactured in a complete range of sizes for engine ratings ranging from 250 hp. to 3,500 hp. and it is practicable to use two turbochargers for engines rated above 3,500 hp. The new line of turbochargers is designed to fit the same space and mountings as those formerly produced.

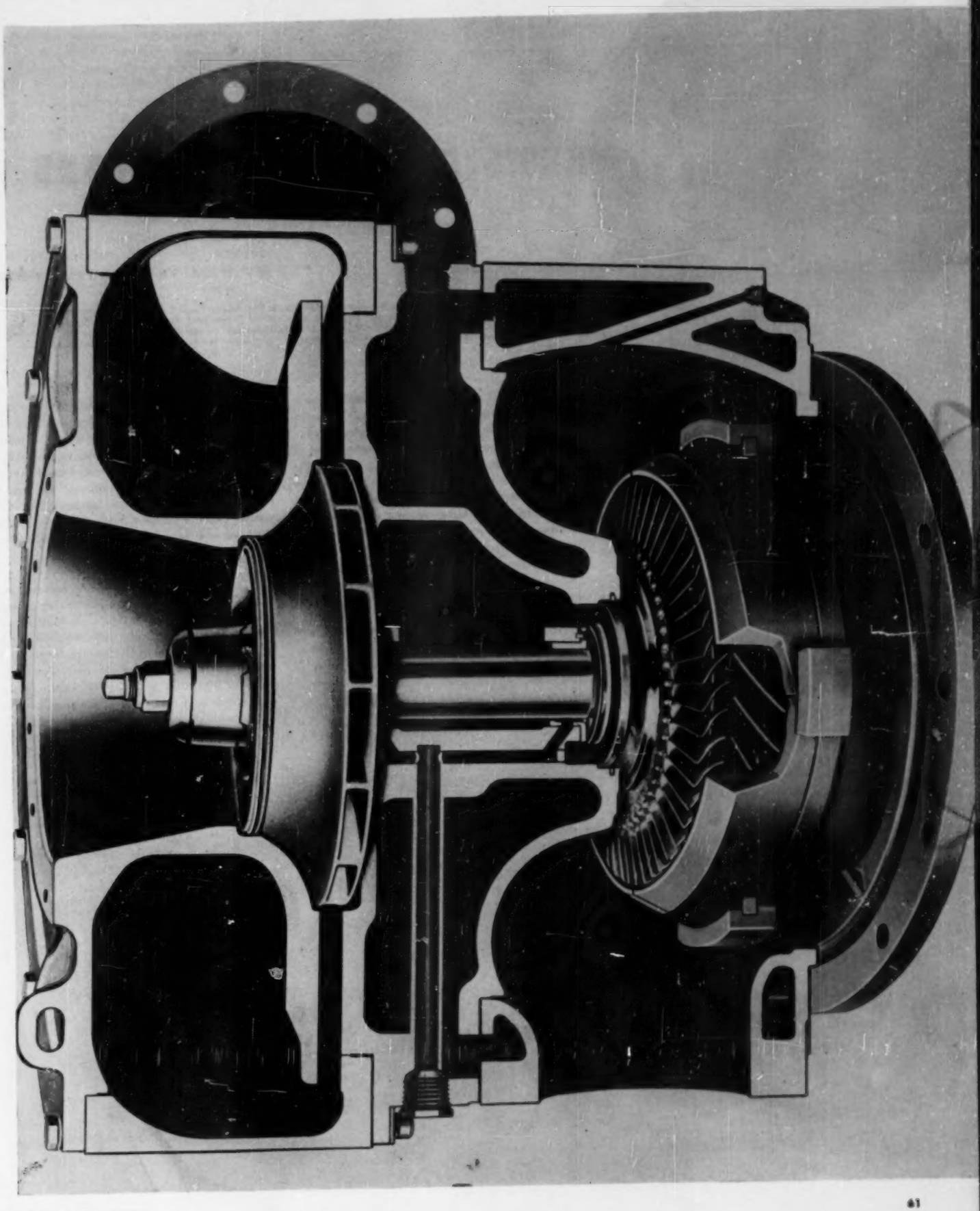
The Elliott Company completed and put into operation in May, 1948, a new building unit, at its Jeannette, Pa., plant, expressly for the manufacture of turbochargers. This building houses a large number of percision tools and equipments, specially designed for the mass production of turbochargers. Line production methods are carried out to such an extent that each step in the manufacture of turbochargers follows in logical sequence and under complete control up to final and rigid tests and preparation for shipment. With this new line of turbochargers, embodying balanced design and rugged construction and offering a range of supercharging pressures almost three times that of the former machines, also equipped with every modern production facility, the Elliott Company makes its bid to engine designers, builders and users alike, who want to take more and more power out of their engines.

An Elliott high-pressure turbocharger mounted on a Lima-Hamilton locomotive diesel which operates on a b.m.e.p. of 165 psi.



Cutaway view of the new Elliott turbocharger showing simple shaft with bearing between the turbine and blower rotors. These new units have the same mounting and space requirements as turbochargers previously supplied by Elliott Company.

Principle operating sub-assembly of the Elliott turbocharger consisting of shaft, blower and turbine.



WHAT'S GOING ON IN ENGLAND

CONDUCTED BY **HAMISH FERGUSON**

Hamish Ferguson was appointed Secretary to the Diesel Engine Users Association in London in 1944. Previously senior technical assistant to Diesel and Insurance Consultants, London, and for several years with English Electric Company in the designing and erection of large diesel generating plants. Mr Ferguson continues to do independent consulting work.

THE 1950 Commercial Motor Show in London contained a greater variety of exhibits than ever before and both home and overseas buyers attended in force. One hundred and seventy-seven vehicles and chassis out of the total on show were fitted with diesels and it is evident that the petrol engine is rapidly being ousted by its sturdier brother.

The largest and most powerful vehicle displayed was the Thornycroft "Mighty Antar" tractor primarily designed as a tractor for machinery. Weighing 15½ tons unladen, it has a wheelbase of 21 inches, an overall width of 10 feet 3 inches, and an overall length of 31 feet 10 inches. It has three axles, a main and auxiliary gear box and tandem drive with a double reduction in both rear axles. It is powered by the 240 bhp. Rover "Meteorite" engine already described in our October issue.

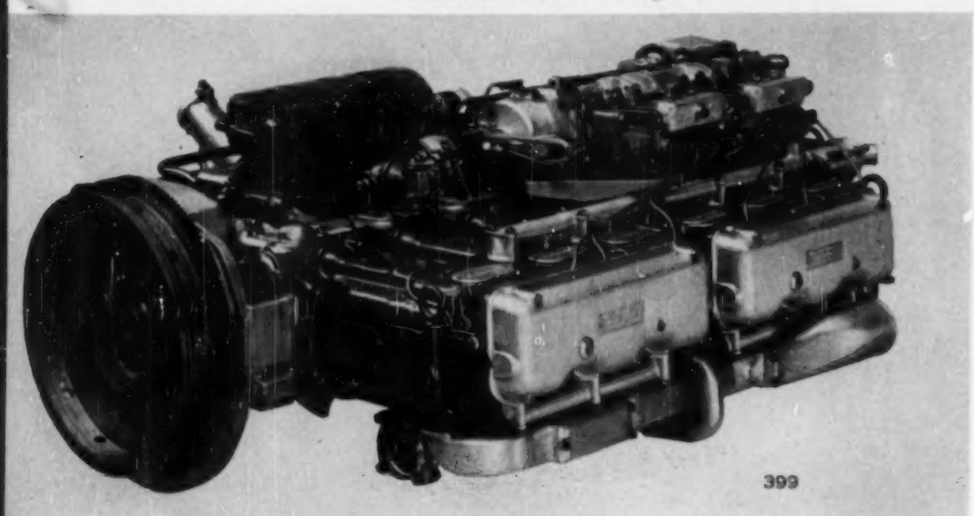
Daimlers, builders of petrol-engined motor cars for over 50 years, have now brought out a diesel for installation in their transport vehicle chassis. Model C. D. "650" has six cylinders with bore and stroke 5x5½ inches. It is a 4-stroke engine developing 124 bhp. at 1,800 rpm. A good feature in the design is the high position of the camshaft which enables very short push rods to be used. Silicon alloy pistons are employed and by the fitting of chromium plated rings in each top groove it is claimed that the rate of cylinder wear is greatly reduced. Oil filtration has received special attention and in addition to a full-flow filter of Daimler manufacture, magnetic filters are incorporated in the main oil line.

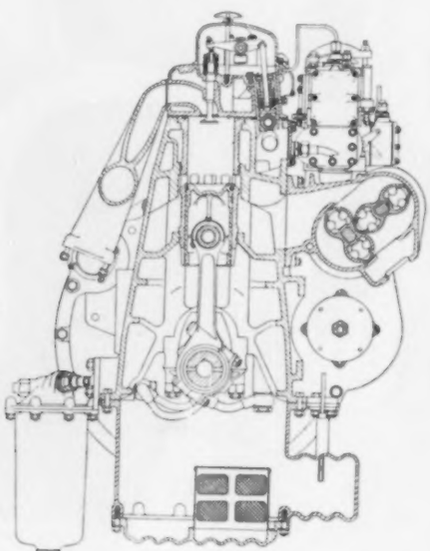
A novel feature of the Leyland 40-seater Royal Tiger coach, fitted with the Leyland underfloor engine, is that the interior is pressurized with a ventilating system that provides a complete change of air every 2½ minutes. The intake air is drawn in through filters by electric fans and passes over thermostatically controlled heaters before being distributed throughout the coach. Air leaves the coach at floor level and can be used for cooling the engine.

The well-known Gardner "L.W." type engine continues to hold its popularity with commercial vehicle manufacturers and in view of the increasing demand for the underfloor type engine, Gardners have produced their "H.L.W." model. This 8.4 litre 6-cylinder 4-stroke engine has a bore and stroke of 4¼x6 inches and develops 112 bhp. at 1,700 rpm. The majority of the engine components are of the same design as for the vertical engine with the notable exceptions of the crankcase and sump which have been modified to provide a very compact and flat engine.

C.A.V. have carried out considerable research into "pilot" injection with a view to reducing "diesel knock" which can be a source of annoyance particularly in passenger-carrying vehicles. The knock is caused by the sudden rise in cylinder pressure when rapid combustion of the fuel takes place following the delay period. The object of the pilot system is to inject a small charge in advance of the main charge so that the pressure rise will be smoother. This object can be achieved by the use of two fuel pumps and injectors for each

Gardner 6HLW flat bed diesel engine.



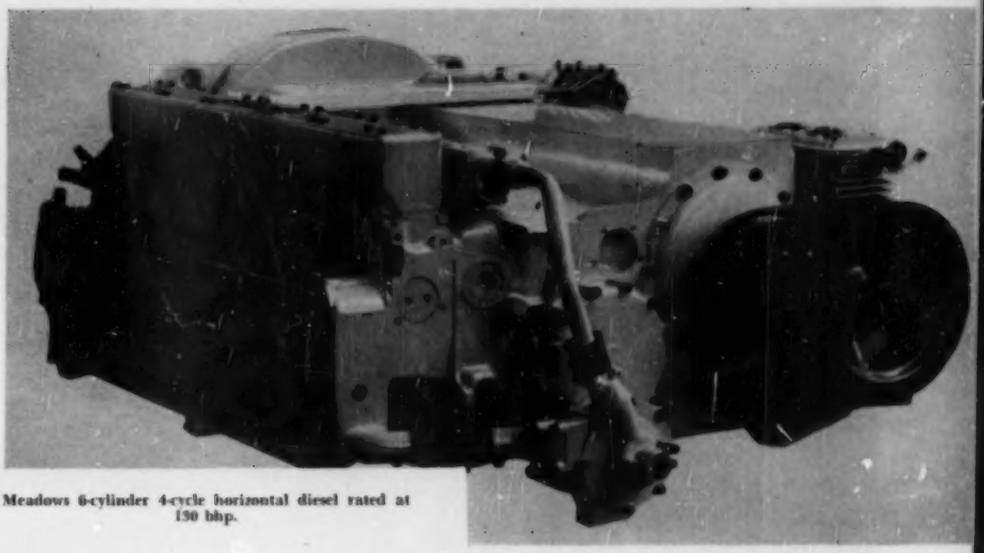


Cross-section of FD6 engine.

cylinder, but this method would not be economically sound. C.A.V., therefore, have tackled the problem by designing a 2-stage fuel cam and modifying the fuel pump delivery valve and the injector. Very promising results are being obtained and the smooth running of engines at slow speed when fitted with pilot injection is most marked.

An exhibit attracting much attention was the Foden F.D.6 2-stroke engine. It is a 6-cylinder engine having a bore and stroke of 5.35x4.73 inches and it develops 126 bhp. at 2,000 rpm., b.m.e.p. 100 psi. The weight of the engine without its electrical equipment is only 1,100 lbs. The engine operates on the uniflow scavenge principle, air being provided by a Roots blower to the inlet ports in the cylinder liner and the exhaust escapes through two cam-operated valves in each cylinder head.

Development work began as long ago as 1938, but it was not until the Kedenacy principle was incorporated in 1942 that real progress was made. Fuel consumption is now 0.408 lb. bhp./hr. at rated full load, falling to 0.392 at 1,300 rpm. A figure of less than 0.4 is obtained over the speed range between 1,100 and 1,800 rpm. During a road test over a level route over a distance of 16.5 miles with a gross weight of 22¼ tons the fuel consumption proved to be 1.35 mpg.



Meadows 6-cylinder 4-cycle horizontal diesel rated at 130 bhp.

Yet another newcomer to the underfloor class engine is the Meadows 6 D.C.H. 4-stroke horizontal having 6 cylinders and developing 130 bhp. at 1,900 rpm. This engine was noticeable for its clean lines and absence of projecting parts.

Never before has there been such a wide range of commercial-type diesels from which to choose and visitors to the show were left with the impression that the British diesel industry can cater for the requirements of any of the world's countries.

The Thornycroft "Mighty Antar" tractor powered with the "Meteorite" 240 bhp. diesel described in the October issue of Diesel Progress.

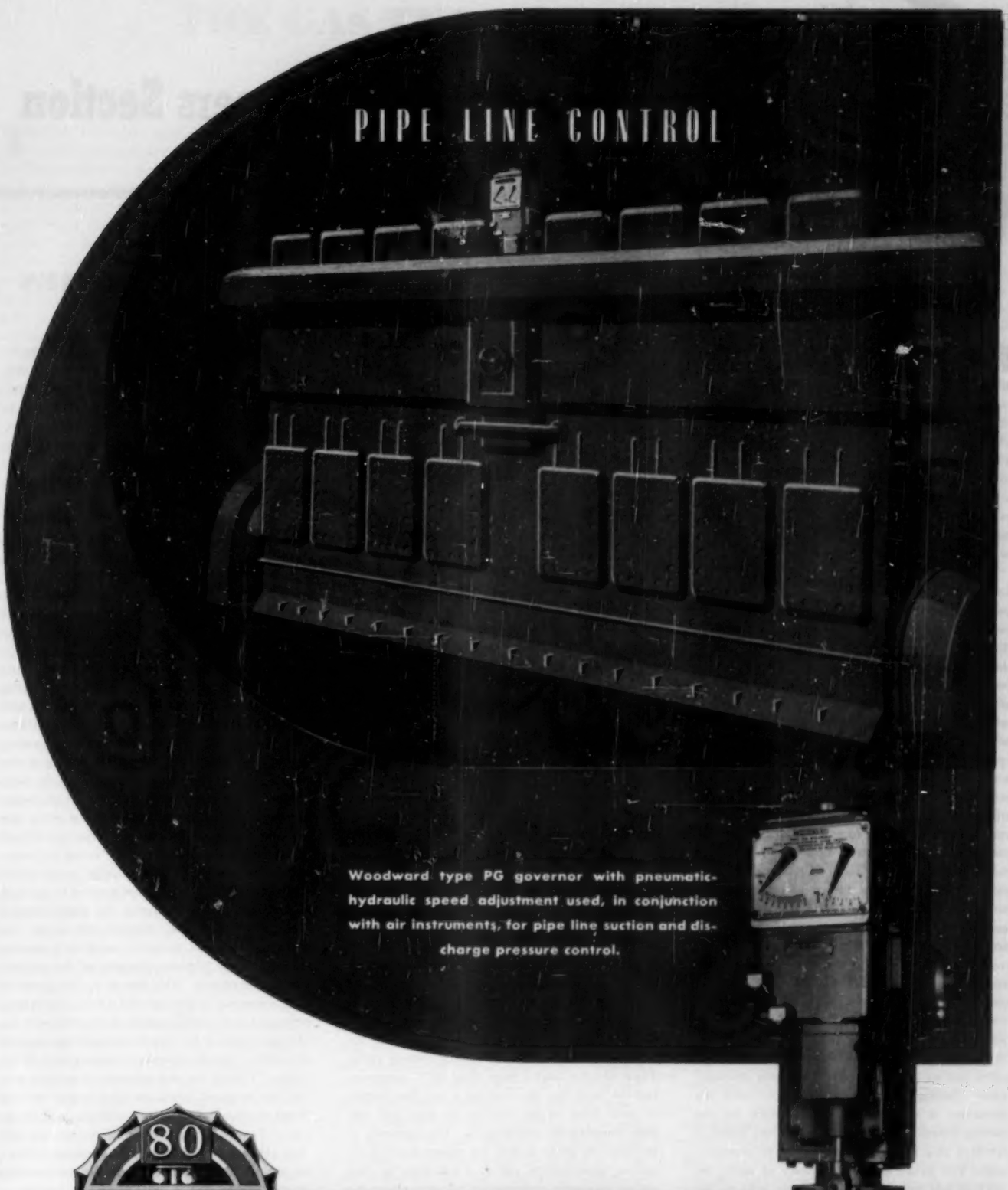
DIESEL SHIP "L.L.WRIGHT"

THE new single screw towboat *L. L. Wright* is not the most powerful towboat on the inland waterways, but she is one of the most versatile. Designed and builtby by St. Louis Shipbuilding & Steel Co., the *M/V L. L. Wright* is one of the first towboats designed to operate from Houston, Texas, to Chicago, Illinois. The stern of the boat is designed for towing on a line in the intracoastal canal, and the pilot house is of the raising and lowering type as required for operating in the Chicago area. A series of river trials were run with loaded barges under actual operating conditions, and trials were made before the Kort nozzle was installed and also after the Kort nozzle was installed. The tests showed an excellent performance even without the Kort nozzle, but with the Kort nozzle and contraguide rudder installed, the tests showed a 32 per cent gain in performance at a pool speed of 10 miles per hour. Built for Martin Oil Service, Inc., of Chicago, Illinois, the *L. L. Wright* will be used primarily in the transportation of petroleum products. The hull is 100 feet long, beam 26 feet, and depth of 9 feet, with a loaded draft of 7 feet 0 inches. The hull has a model bow with easy flowing lines, and these easy lines continue back to the stern, where a high speed Kort nozzle is installed. The hull is of heavy, rugged construction with a minimum of ⅜-inch plate being used on the shell and bulkheads. The bilge plate is ½-inch and heavier plating is used around the propeller. All bulkheads are stiffened both vertically and horizontally. The fuel for the diesel engines is carried in hull compartments which have a capacity of 21 days' fuel supply. Wash water is also carried in hull compartments, and the potable water is carried in separate tanks. The deckhouse is of steel construction, with Truscon steel sash and steel outside doors. All exterior walls are insulated with 2 inches of Fiberglas, and the lining and partitions are of ¼-inch tempered Masonite. As previously mentioned, the pilot house is of the raising and lowering type. This is accomplished by mounting it on a 12-inch hydraulic ram.

Quarters are provided for a crew of 10 and a guest room, and because of the low vertical clearance required to operate under the Chicago bridges, all the quarters are on the main deck. The galley is equipped with an electric refrigerator and an 18 cubic foot deep freeze cabinet. The oil burning galley range is a Shipmate Model No. 540. The sink has a double drain, stainless steel top, and meets the requirements of the U. S. Public Health Service. The *L. L. Wright* is powered with a General Motors (Cleveland Division) diesel engine, fitted with a Falk 3-to-1 ratio reverse-reduction gear and Airflex clutches. The engine develops 1,200 hp. at 750 rpm., and with the 3-to-1 gear, turns a 4-blade propeller at 250 rpm. The controls for the engine and for the Airflex clutches are controlled directly from the pilot house. The main engine and auxiliary engine are cooled by a St. Louis Ship built-in skin cooling system, and the lube oil coolers are of a size to cool the oil, using the water from the enclosed cooling system. Engine cooling is controlled by an automatic temperature regulating valve. The only pump connected to the sea chests for using river water is the fire pump. A contraguide steering rudder improves the boat's propulsive efficiency and also assures it of good steering power. Two backing rudders are also provided with separate steering gears provided for the steering and backing rudders. The two steering gears are of the St. Louis Ship electro-hydraulic type with electric follow-up. The propeller shafting is of steel, fitted with sleeves at the stern tube and stern strut bearings, and the 4-blade propeller is of cast steel. The stern tube bearing is oil lubricated and the stern strut bearing is a Goodrich cutless rubber bearing. Two 5-hp. motor driven air compressors provide the air, at 400 lbs. pressure, for starting the engines and, through pressure reducing valves, also provide air for the Airflex clutches. The electric power is provided by a 15-kw., 125-volt d.c. tailshaft driven generator, and a 30-kw., 125-volt d.c. diesel engine driven generator, and an Exide 112-volt marine battery floats on the line. Two 14-inch Carlisle-Finch arc searchlights with hand-wheel controls are mounted on the forward corners of the pilot house with the top of the searchlights below the top of the house. The searchlights raise and lower with the pilot house.

With the combination of "easy" lines, a slow speed propeller, Kort nozzle and contraguide rudder, the *M/V L. L. Wright* represents the very latest in modern towboat design, and is proving herself to be one of the best towboats of her power on the rivers today.

PIPE LINE CONTROL



Woodward type PG governor with pneumatic-hydraulic speed adjustment used, in conjunction with air instruments, for pipe line suction and discharge pressure control.

80 '16 WOODWARD SERVICE

WOODWARD GOVERNOR COMPANY

ROCKFORD, ILLINOIS

World's oldest and largest exclusive manufacturer of hydraulic governors for prime movers.

Supervising & Operating Engineers Section

CONDUCTED BY R. L. GREGORY

SOME EXCEPTIONAL CASES OF OPERATING DIFFICULTIES

EVERY now and then we hear of some diesel unit which has been forced out of service, due to the failure of some of the auxiliary apparatus. This is exceptional, however, and it can be a situation which can arise in any plant, even those who follow a well defined maintenance schedule. Two or three such incidents have been called to the attention of the writer within the last few weeks, and since these conditions can arise as previously mentioned we will take these instances up and discuss them and give our suggestions as to how to avoid their repetition.

Case one involves the failure of the circulation pump on the cooling system of a large unit in an industrial plant. The ironic part of this case is that the entire unit and auxiliaries had undergone the annual overhaul just a couple of weeks previously. The unit had been checked thoroughly along with all the auxiliaries. The pistons among other things had been cleaned and refitted with new rings throughout, and the unit had been in operation long enough to have these rings well worn in. The operator in charge had made his rounds as usual and taken his log readings and entered them. Conditions were found to be normal on this inspection round. Then he had left the engine room to attend to some of his other duties in the adjoining room. Upon returning to the engine room about fifteen minutes later he noticed that the unit seemed to be laboring and immediately discovered that his cooling agent was around the 200-degree mark. He immediately removed the load and shut the unit down. Further investigation showed that the motor driving the cooling agent pump had failed, shortly after his inspection round, and as the unit was operating at about 85 per cent load, it had quickly heated up. Now, as is the case in most large units of this type, safety alarms had been installed by the manufacturer. Among these was an alarm to warn the operators of any excessive temperature on the cooling system. However, this alarm had failed to function at a critical moment with the above results. The writer is a firm believer in safety devices of this nature, but has always held to the theory that they are not entirely dependable and should be augmented in other ways. Even though they are diligently and religiously maintained, they have a habit of failing at the most inopportune moments. He has further maintained that the duties of an operator should not be such, that he is required to get away from his units for more than a minute or two at a time, and that large units should never be left unattended longer than that moment or so. That is the best safety measure. But to get back to this case. The alarm showing excessive cooling temperature did not function, but the operator did get the unit out of service right at the critical moment, just bordering upon piston seizure. After allowing the unit to cool down normally for several hours, some of the pistons were removed and it was noted that they were on the border line of seizure, but had missed it by practically seconds. A thorough inspection was made of the unit and the only question upon which all did not agree was as to how the rings would function after being subjected to this excessive heat. Apparently they were still satisfactory and it was decided to leave them in the unit. Later developments proved, however, that they had lost some of their tension and it was decided to replace them.

Getting back to the safety alarm which had failed to sound a warning, since most large units are equipped with these alarms, the natural conclusion would be if they are properly maintained, that they are dependable. In most modern installations the writer feels that manufacturers go all out to the extent that they overdo themselves in making complicated hook-up and interlocking hook-ups on many of these devices. Simplicity of hook-up and operation of such devices should be the rule, rather than the exception. At our plant we do not depend on the safety devices as furnished and hooked up by the manufacturer and installer. In the cylinder heads of each unit which we operate in our plant, we have installed on the two end cylinders a simple temperature control switch with the bulb extending into the circulating cooling agent. These switches have a range from 60°F. maximum and the limits can be set within a very few degrees of each other as the relation between low and high temperature adjustments. For instance, as an example, presume that the temperature of the cooling agent runs to 140°F. at full load, we then set our maximum temperature 5 degrees above this point, or 145°F. Now if for some reason the cooling agent exceeds 145°F. this control switch closes and closes the circuit to a large Klaxon horn and indicator lamp. The horn starts blowing and the lamp lights, indicating which unit is in distress. This maximum limit is still several degrees under the allowable maximum as set up by the manufacturer and gives ample warning so that the operator can detect the fault before any damage has been done. Each engine has its own separate auxiliary alarm system on the cooling agent, consisting of a temperature control switch in each end cylinder head, a 110-volt Klaxon horn with an indicating light, each unit having a different colored light. This alarm system is connected direct to its own switch, which is supplied from the house current. These alarm systems are inspected periodically and can be tested very easily by manually changing the maximum temperature setting down to the actual operating temperature. When tested they are reset at 5 degrees above normal operating temperature.

Case two—This case actually was the same in two separate plants, and had to do with the plugging of fuel oil purifiers between the storage tank and the service tank. In both instances the cartridges were plugging up so often that they were causing trouble and added expense due to having to frequently change the filter charge. And in both instances these plants were using a fuel oil purge. However, neither purge seemed to be doing the job, and that in conjunction with the type of fuel being used and which they were trying to purge, gave them trouble. The particular purge which they were trying to use was not adapted to the type of fuel used. In one instance the plant changed fuel and in the other instance the purge was changed. In both instances satisfactory results, eliminating the frequent plugging of the purifier, were accomplished. This brings up the point of fuel treatments. There are still a lot of supervising personnel who cannot console themselves with the idea that there is any benefit derived from fuel oil treatment. As one supervisor recently said to the writer: "I don't see any necessity of treating fuel oil. We operated diesels for years before we ever heard of these fuel oil purges and got good results too." That statement, I told him, was entirely true. However, with the ever-increasing demand for fuel oil, there has been a definite deteriorating in the quality and an ever-increasing amount of contamination. To overcome this situation and make the fuel oils more usable and satisfactory, many different fuel treatments have appeared on the market. Some are excellent, others are good, and many of them are practically just a product to

. . . and now please turn to page 74 . . .

THE GAS TURBINE ? - NOT YET

THERE is not yet sufficient factual data to establish that the gas turbine is, or will be, more economical or more attractive for general railway use than the diesel locomotive. This statement is contained in the conclusions of a paper upon "Diesel Engines or Gas Turbines for Locomotives?" included for round table discussion at the Pan American Railway Congress in progress in Mexico City from October 10 to 20. The paper was prepared by Mr. N. C. Dezendorf, Director of Sales of Electro-Motive Division of General Motors Corporation, LaGrange, Ill. Mr. Dezendorf is a member of the Industrial Advisory Committee of the United States National Commission in the Railway Congress. General Motors is one of the world's largest builders of diesel locomotives at LaGrange, Illinois, and through its experience in building gas turbines for aviation use is conducting an extensive investigation of the possibilities in other applications of the gas turbine at its Allison Division at Indianapolis, Indiana.

The paper, which reviews the history of the gas turbine development and its progress to date, also concludes: "There seems, furthermore, little immediate prospect that the gas turbine will establish such outstanding economic advantages compared with the diesel, to justify the premature claim that the proven economies of the diesel locomotive will be quickly surpassed. Operational problems, such as variations in output with variations of temperature and altitude, and sustained high efficiency over a wide range of loads, may take some years to solve. A gas turbine locomotive would still retain all the electrical equipment and running gear of the existing diesel locomotive, representing perhaps 80 per cent of the whole in terms of initial cost and annual charges such as interest, depreciation and maintenance.

"The main features of the gas turbine, such as lightweight and small size, have no particular advantage in the locomotive application. Accordingly, the incentive to develop the gas turbine for locomotives is less than in many other applications, particularly aircraft and stationary uses. It appears sensible, therefore, to adopt a forward policy as follows: (a) Let the gas turbine develop firstly in the applications such as aircraft, power stations, and other stationary applications where it has a natural advantage and then apply, so far as possible, this development work to the locomotive. (b) Protect the current investment in diesel electric locomotives by concentrating developments in the field of gas turbine locomotives on a power unit which will exactly replace the existing diesel engine prime mover. If and when the gas turbine can be made to show superior advantages and economy, the power unit alone, representing only say 20 per cent of the cost of the locomotive, can then be substituted for the existing engine."

A parallel between popular hue and cry for the diesel engine in its earlier development days and some of the current propaganda concerning the gas turbine is developed in the paper. "About the time of World War I there grew a demand for diesel engines of more compact size and lighter weight for such applications as submarine propulsion, and even as aircraft engines. The latter development was stimulated by a desire for minimum weight of fuel and the elimination of the fire hazard. During this period many enthusiasts for the new type of power made claims for the diesel engine which subsequently proved to be exaggerated. They prophesied that the diesel engine would supersede all the known forms of power, including the gasoline engine in the motor car and the steam engine, in both its reciprocating and turbine forms."

N. C. Dezendorf

The paper then brings out the fact that despite the early overall predictions, "there is no natural economic application for the diesel engine in the automobile," and it has found no real place in aircraft nor in larger power stations. The paper reviews the advantages which led the diesel to supersede the steam locomotive, namely: (1) Compact, lightweight prime mover of reasonably low cost; a satisfactory and efficient form of transmission; and a locomotive unit which could be built in standard sizes suitable for a variety of railway applications by varying only the number of units operating together and the gear ratio on the traction motors. (2) High degree of reliability; a sustained efficiency over the whole range of locomotive working speeds; and the sustained performance under changes of ambient temperature and altitude. (3) Substantial economies to the railroads stemming primarily from a lower fuel cost; the use of relatively small quantities of suitable grades of liquid fuel; a great reduction in water cost; low overall maintenance costs and in intensive applications, lower fixed charges. (4) Finally, public amenities such as cleanliness, the absence of smoke and the reduction of noise.

The paper then develops the question of whether the gas turbine gives promise of retaining these advantages, pointing out the following: (1) The turbine has lighter weight and more compact size than the diesel, but the weight is needed for tractive effort; there may be some "justification for the claim that eventually the gas turbine should be cheaper to manufacture than the diesel engine, the cost advantage at present is in favor of the diesel." The turbine locomotive can be built in standard sizes just as the diesel. (2) "The reliability of the gas turbine cannot yet be claimed as high as that of the diesel engine." When operated at 1,000°F. the blade life of the gas turbine is as long as that of the steam turbine. But efficient locomotive operation involves operating temperatures approximating 1,400°F. "Limitations of pressure ratio and temperature presently limit the efficiency of the gas turbine to little more than half that of the diesel engine. Furthermore, while the efficiency of the latter is sustained at a relatively constant value over a wide range of loads, the gas turbine has much less efficiency at partial loads than at full load. Output and efficiency are extremely sensitive to variations in temperature.

Output increases as the air temperature to the compressor fails. The power unit, therefore, has serious disadvantages when the type of operation to which it is applied involves wide variations in ambient temperature conditions." To a lesser extent output and efficiency are affected by atmospheric pressure. (3) The gas turbine has not yet substantiated claims that it can equal the diesel's economic advantage to the railroads. While the turbine may burn lower cost fuel than the diesel, the lower efficiency of the turbine "may be expected to offset this advantage.

"As yet unproven are claims for lower maintenance cost because of the rotary nature of the equipment, although it does seem probable that the gas turbine will have a lower lubricating oil consumption than the diesel. (4) "While sharing the cleanliness of the diesel, the gas turbine locomotive will have offsetting disadvantages of a high and objectionable noise level and a hazard associated with the exhaust heat discharge."

Summarizing a study of operating costs of the two types, the paper develops that the increased fuel cost of the gas turbine can hardly be recovered by reduced lubricant or repair costs despite the use of cheaper fuel. It must be remembered that operating costs for diesel are factual, but in relation to the gas turbine they are optimistic figures which still remain to be proven. Acknowledgment: To Mr. H. G. McClean, Export Manager of Electro-Motive Division, for research and other assistance in the preparation of this paper.

High-Speed Diesels . . . Design, Operation & Maintenance

CONDUCTED BY H. G. SMITH

LUBRICATING OIL FILTERS

SOME operators of high speed diesel engines have often remarked about the different size and shapes of oil filters used on different engines. The manufacturers of equipment, using diesels, have questioned an engine manufacturer's recommendation to install an entirely different make and size of filter in their equipment than that which is normally furnished as standard equipment on the engine. This is because engines used in clean operation such as stationary installations and on-highway trucks do not require the same type of filtration that is needed for dirty work like strip coal and iron mining as well as dirt dam and road building. The engine designer, knowing that some filtration is essential for the engine, regardless of the operating conditions, selects a filter which he can mount on the engine and a size that will give good filtration for a certain period of time. Such a selection is far from being a simple problem because the space sometimes is limited due to the size of other accessories such as fuel pump, air compressor, generator, hydraulic pump, air cleaner, fuel filter and fan assembly which also must be located on the engine in some convenient location where they can be readily serviced.

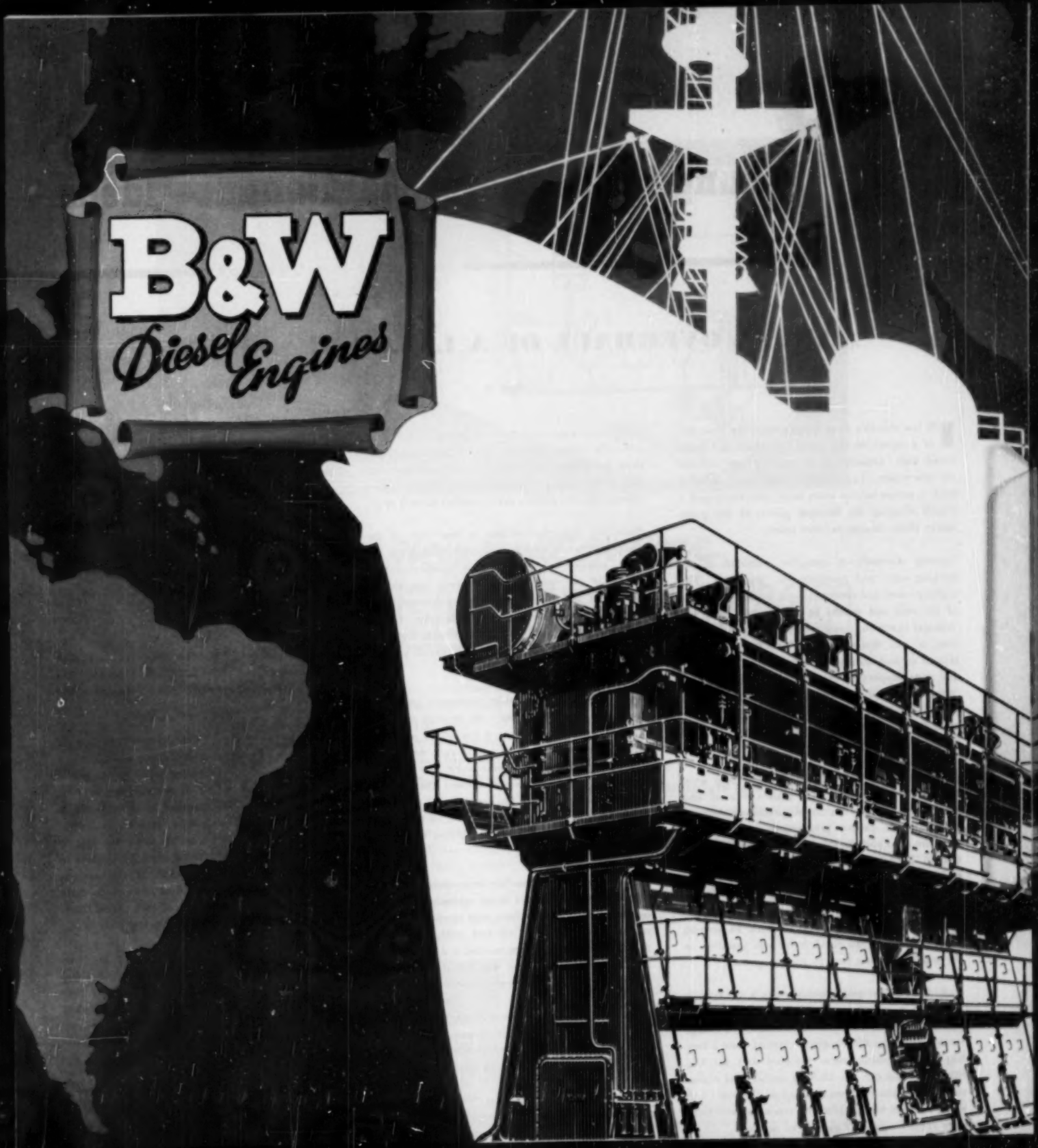
The problem of deciding on the size of a filter and the quality of filtration for a specific installation sometimes leads into quite a discussion. Some operators will express their desire for a filter which will not require frequent element replacement, while others like a filter that does not require such expensive elements but insist on a design that can be quickly serviced. One operator wanted a filter with an element he could unroll or tear apart so that he could see if there were any flakes of bearing material in it and in that way tell how his bearings were standing up. Other operators have remarked about the multitude of different sizes of elements they have to carry in stock for the different engines in their equipment. Regardless of all these opinions and problems of installation, good filtration is what is wanted and needed. A large size filter does not necessarily mean that you have good filtration. It is what is inside that counts and the surrounding conditions. Good filtration will not overcome engine design shortcomings, but a good filter will save a lot of money when it is properly and regularly serviced. In recent years there has been added to some engines a piece of equipment that has done a lot of good for better filtration, but it was really not added for that reason. It is an oil cooler, but should be more correctly called an oil "temperer." It is located in the cooling system and the oil passes through it, keeping the oil at approximately the same temperature as the cooling water, which is an excellent temperature for maximum filtration. Hot oil can be filtered much better and more thoroughly than cool oil. When engines are started up or stand idling for long periods the oil becomes cold and filtration is retarded. Even in filter installations where all the oil goes through the filter before reaching the bearings the filters are equipped with what is known as by-passes. Cold oil won't go through the filters and these by-pass valves open and shunt out the filter until the oil becomes hot enough to pass through the filtering element.

H. G. Smith's background in diesel engineering renders his articles of great interest to those engaged in operation and maintenance of high-speed engines. From the Springfield, Ohio, Technical and Engineering school, he entered the Foos Gas Engine Company, Springfield and later, Springfield Motor Truck. With this experience behind him, he joined Hercules Motors Corporation, where he was chief engineer for many years being with them when their diesel program was started. Executive engineer for Buda during the last ten years, he recently resigned to take up consulting work.

All the filter manufacturers will tell you that their filter will do a much better job if the oil temperature is kept at 180°F. If oil coolers are not available for your engines, then place your filters where they will be kept warm as possible. Many operators in the coal and iron strip mines place their filters inside of the cab. This is a warm spot and a good location for easy servicing. Those of you who are installing your own filters, as some operators are doing, should be sure that the lines leading from and to the filter are large enough. Make the lines as direct and as short as possible and be sure the size of the filter selected is large enough to take the full capacity of the engine lubricating oil pump. Another point of good filtration is the selection of the replacement elements. Don't buy on price, buy on quality. A few cents saved on the price of the element may mean dollars damage to the engine.

Element design and the materials used vary quite widely from one filter manufacturer to another, but through scientific study these different manufacturers have studied the material they use and put it in an element pack in such a way that it gives the filtration they claim. On the other hand, the replacement element business has attracted some companies that have not studied the problem scientifically. They make an element that, from manufacturer's product but will lack the filtering all appearances, is just as good as the reputable quality and you will never know the difference until more rapid wear will occur in your engine. There is no way possible for the average operator to ever tell the difference between two different elements, unless he would go to the trouble of making oil analysis and check his wear pattern of the various parts of the engine. Even then it is difficult to put your finger on the gyp element because he probably would blame your trouble on something else, such as the oil. This gyp element business is quite a serious item in your budget and if you want to save yourself some money, buy your elements from the filter or engine manufacturer. You can pick out these gyp companies from the reputable ones. The reputable companies not only make elements, but also the complete filters. It is best not to buy from any company that only makes elements.

DIESEL ENGINE CATALOG is just off the press in its Fifteenth Edition. Completely revised and up-to-date, it is invaluable to design engineers and buyers.



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Exchange Your Diesel Maintenance Ideas

CONDUCTED BY R. L. GREGORY

ANNUAL OVERHAUL OF A LARGE DIESEL UNIT

Part 2

IN last month's issue we discussed the first part of a report on the annual overhaul of a large diesel unit. Continuing in this issue we will finish this report. Last month's issue was concluded with a survey of the cross head clearances and a sketch showing the location points of the guide where these clearances were taken.

Starting Assembly—A complete overhaul of the starting valve and assembly was conducted. The starting valve and assembly is an important feature of the unit and should be kept in first class mechanical operating condition at all times. Therefore, it was dismantled and checked, the valve lapped in and thoroughly lubricated. The rollers and pins supporting them were checked with the cams and found to have an excessive amount of play. Therefore, six new rollers and pins were installed with the proper amount of tolerance in each and the whole reassembled.

Lubricators—All the individual lubricators were dismantled on the unit, sight glasses cleaned, and filled with a new solution of glycerin and water mixed in the proper proportions. New gaskets were installed and the lubricators reassembled after testing. Each lubricator was then set at one pulsation above normal operating setting. This was done to give added lubricant to the liner walls until the new rings were worn into position, at which time they were retarded back to normal position. A new oil check valve was installed in the top lubricating line to the compressor.

Lube Oil Purifier and Crankcase—As is our custom whenever a complete overhaul has been accomplished, the lube oil filter was drained, old charge removed and the filter entirely cleaned, then a new bag and accessories were installed and the bag filled with highlite, the filtering agent. The crankcase had previously been drained and cleaned and when all were reassembled the crankcase and filter were refilled with 650 gallons of new oil.

Compressor—This unit, being an air injection unit, has a three-stage compressor, which was checked over and inspected. The three stages of compression, namely high, intermediate and low, were inspected, and since the suction and discharge valves in all three stages had been in operation for some time, they were removed. The chambers housing these valves were all cleaned of any excessive foreign matter and a complete set of reconditioned valves with new gaskets were installed in each stage.

Atomizing Equipment—This is one part of the equipment which gets a periodical checkup on frequent routine inspection. This equipment consisting of the atomizers themselves, the needle valves and packing and the flame plates and flame plate caps, had recently been gone over. Consequently when again inspected they were found to be in excellent shape and were replaced without added maintenance.

Fiat Valves—It is our custom to inspect and clean the Fiat valves periodically on routine maintenance. This had been done a few weeks previous, but since we were making a thorough overhaul it was decided to remove these valves for another inspection. This inspection showed them to be in good shape and with the exception of one valve plate, all were cleaned and replaced. A new valve plate was installed in place of the one which was partially defective.

Fuel Pumps—This is another item which we check periodically and inspect as to operation. We do not let these parts go from one annual overhaul to the next. However, all fuel pumps were dismantled and two of them needed a slight lapping in. One new check valve was installed and each individual fuel pump then reassembled.

Governor—The governor was inspected and checked for linkage wear, all parts cleaned and resprayed with oil. Dash pots were checked and the governor mechanism found to be in good shape.

Miscellaneous—All auxiliaries were checked, including pumps, motors, auxiliary air compressure, gauges and alarm systems. Some of these items, such as pumps, were repacked, and piping cleaned, especially blowdowns from the various compressor stages and cooling coils. When the unit was entirely reassembled we were ready for a test run.

Test Run and Checking—The unit was started up at 1:30 p.m. and the load built up to 500 kw. As previously stated, excess lubrication of one pulsation per minute was given to the various pistons, while the rings were wearing in. After eight hours of operation the unit was removed from the line, as it was no longer needed to meet plant load demand. The following morning the unit was again placed in service and load raised to 1,000 kw., where it was allowed to operate for an additional four hours. Cards were then taken with the following results:

Cylinder No.	1	2	3	4	5	6
Firing Pressure	595	610	590	600	610	560
Compression	520	522	522	515	542	530

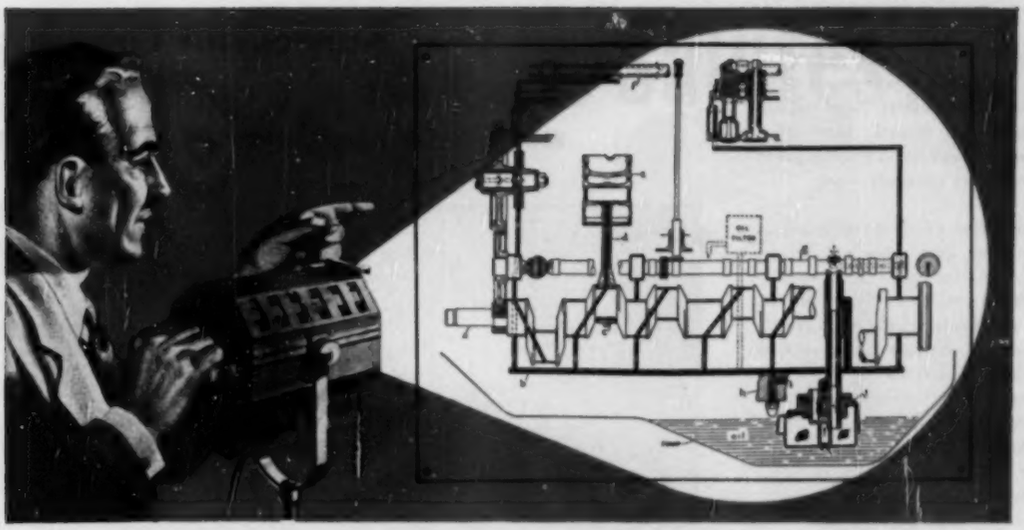
Load 1,000 kw.—Scavenging Air 2.5 lbs.—Blast 850 lbs.

From the foregoing it was deemed necessary to make some adjustments and the unit was taken out of service and the following adjustments made. The compression on No. 5 cylinder was deemed too high and this was remedied by the removal of a one-thirty-second inch shim from the rod bearing. The firing pressure on No. 6 was too low, so the cam setting was advanced from 7½ degrees to 9 degrees. When this was completed, the unit was again placed in operation and allowed to carry 1,000 kw. load. At the end of this period cards were again taken with the following results:

Cylinder No.	1	2	3	4	5	6
Firing Pressure	595	610	590	600	605	590
Compression	520	522	522	515	520	520
Exhaust Temp.	290	285	285	285	290	285
Cam Setting, btc.	10°	10°	8.5°	8.5°	10.25°	9°

Load 1,000 kw.—Scavenging Air 2.5 lbs.—Blast—850 lbs.

The foregoing completed the job of this overhaul and this data as given was placed in a folder, along with a list of all new material used and man hours used in the job . This gave us a complete record on this particular overhaul and listed on a special job No. 3579. When the next annual overhaul comes up we have in our files a complete report on the previous job and a record for comparison's sake on future jobs. In this manner there is no guesswork, since all data is a matter of record.



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Associated Equipment Distributors Stage Very Successful Convention at Santa Barbara, California

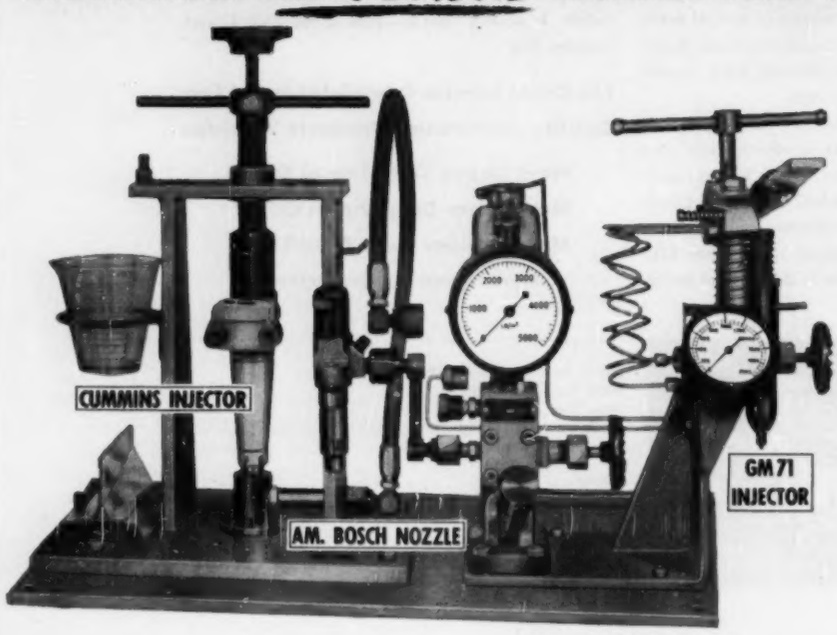
REGION two of the Associated Equipment Distributors held a very successful convention at the Santa Barbara Biltmore Hotel, Santa Barbara, California, on October 26th and 27th. Photograph shows most of the men who attended.

Under the able direction of Beal Shaw, director of Region Two, two very useful days were put in by some fifty equipment distributors from California, Nevada, Arizona and Hawaii. Your editor attended this convention and found the discussions more than interesting and extremely timely.

On Thursday John Server, editor of the *Southwest Builder and Contractor*, gave a fine talk on the construction picture in the west. This was followed by W. H. Barber, vice president of the San Diego chapter of the Associated General Contractors, who talked on Construction Industry's Role in the World Today. Then Frank A. Nikirk, Professor of Civil Engineering, University of California, gave one of his unforgettable talks on Training Engineering Students for Contractors' Organizations. Professor Nikirk has done and is doing an outstanding job of training college men for useful work in the contracting field. The question and answer period which followed showed the keen interest the men attending this convention took in the papers and the subjects discussed.

On Friday the panel discussions held the full attention of everybody. Such subjects as Dealers' Participation in Sales Made by Manufacturers Direct to Government was typical. A good meeting.

BACHARACH *UNIVERSAL* NOZZLE AND INJECTOR TEST STAND



This is the most versatile and easy-to-operate piece of equipment ever offered for testing nozzles and injectors of all Diesels up to 60 hp per cylinder. The heart of this test stand is the Bacharach Nozzle Test Pump located in the center. Nozzles made by American Bosch, Bendix, Caterpillar, International Harvester, etc. are attached directly to test pump by means of steel tube and union nuts. Cummins injectors are held in test fixture at left; GM 71 injectors in test fixture at right. These fixtures have individual fuel pressure lines which may be interchangeably connected to test pump.

Test Set includes Connector Set 44 comprising connector tube, Ermeto adapter and fuel inlet connecting nuts for all American Bosch R, S and T size nozzles and similar size nozzles of other makes. Nozzle test pump or test fixtures may be purchased separately, if desired.

Write for Bulletin 901

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Supervising and Operating

... continued from page 66 ...

be sold. There is one point that should not be forgotten, and that is that you must have the right fuel treatment in treating your fuel, since all fuels do not react the same to the same fuel treatment. It boils down to a case of cut and try and the fuel treatment that gives you the proper results is the one to use.

Case three—This particular case concerns a unit where all the connecting rods and main bearings were lost with a resultant scored crankshaft. It has not been fully determined as to just what the cause of this failure was, but it evidently must have been due either to failure of the oil circulating equipment or faulty oil, either of which might have caused this situation. It's a pretty difficult matter to determine the condition of lubricating oils as received, without the proper equipment for checking. Many barrels of lubricants stand out in the weather when in storage, and it is an easy matter to get a barrel of contaminated lubricant, which if added to a crankcase of good oil will eventually contaminate even that which is good. So a lot of care must be taken in the matter of lubricants. The above condition probably would not have developed had a positive temperature alarm system been installed, since there must have been a lot of excessive heat developed in the process of wiping these bearings. Here was also another instance of where the unit was not under observation at all times by the operator.

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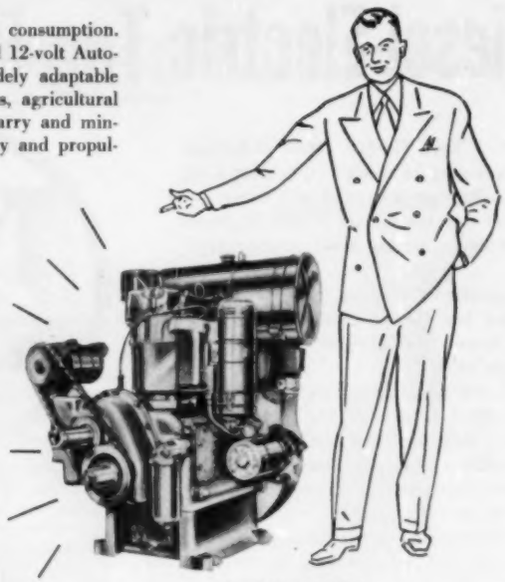
Write for details. Outline your requirements. Address Dept. DP.



2 cyl. Model AS-2

Lister-Blackstone

LISTER-BLACKSTONE, Inc.

Factory, Sales & Service Headquarters:
420 Lexington Avenue **New York 17, N. Y.**

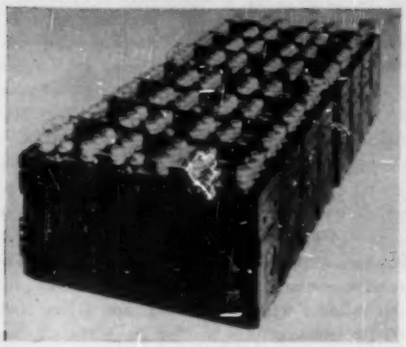
New Binks Plant for California

To better serve the rapidly expanding industrial west, the Binks Mfg. Co. has purchased a substantial new plant located at 4915 Pacific Boulevard, Los Angeles. The rapid growth of Binks business in the Los Angeles area over the past 10 years made present quarters inadequate. According to Burke B. Roche, Binks' president, the new quarters were selected with two objectives in mind: to provide immediate better service to Binks' customers and to allow for future expansion of plant to keep abreast of industrial growth in the Los Angeles area. The plant is designed for light industrial work. It is operated under the direction of J. E. Roche, manager of the west coast division, covering the seven states of California, Oregon, Washington, Arizona, Utah, Nevada and Idaho.

This office is the focal point for all branch office work involving the warehousing and selling of standard spray finishing and water cooling equipment and the assembly of air compressors. Spray painting booths and water cooling towers will be assembled here from parts made in Chicago. There will be some sheet metal fabricating. It is expected that manufacturing processes will be expanded in the future.

The Vernon district, in which the plant is located, is easy to reach by public transportation. The building is 80x140 feet, on a lot 100x250 feet. A private railroad spur to the rear of the plant eliminates double handling of raw materials and unassembled parts. The modern building, formerly occupied by the Allegheny Ludlum Steel Corporation, is of concrete construction, with a rigid steel frame, saw tooth roof. The office extends across the front. The one-ton cranes will expedite the handling of materials and finished equipment. Most of the yard is paved, providing ample loading and trucking facilities. Previous to the opening of the new Los Angeles plant, many Binks products had been shipped from the home plant in Chicago. The Binks Mfg. Co. manufactures a complete line of pretision spray finishing equipment, including spray guns, air compressors, automatic spray finishing equipment, oil and water extractors, hose and related items. Major projects of the Binks Water Cooling Division are industrial spray nozzles and cooling towers, designed to cool liquids used in various chemical and refining operations and to cool water used in air conditioning and refrigeration systems. Binks cooling towers permit re-use of cooling water—a matter of crucial importance in times of water shortage.

New Nickel Cadmium Battery



A new T-Type Nickel Cadmium Alkaline Battery, designed specifically for starting railroad diesel engines and manufactured by the Nickel Cadmium Battery Corporation, makes it possible to save as much as 100 man hours a year, per locomotive, because of reduced maintenance. It is also lighter in weight than conventional batteries and requires no additional space or alteration in existing battery racks. The Nicad T-Type Battery is available in two capacities: model THR-30, 142 ampere hours, in eight 6-cell trays, which is interchangeable with 17-plate, 284 ampere hour conventional batteries, and model THR-44, 210 ampere hours, which is interchangeable with 25-plate, 426 ampere hour conventional batteries. Model THR-30 weighs 1,825 pounds and model THR-44 weighs 2,675 pounds.

One of the features of the T-Type Battery, in addition to interchangeability, light weight and minimum space requirement, is the inherently long life characteristics of the Nickel Cadmium type of battery and its maintenance of capacity even after years of severe use. Containers, cells and plates are of steel construction. Among those factors that play an important part in the reduced maintenance costs of Nicad batteries are (1) their all-steel construction, which eliminates breakage, (2) their ability to be over-charged without damage, which overcomes one of the common causes of lead battery failure, and (3) their negligible water consumption. The T-Type battery can also be charged with standard charging equipment at trickle, normal, or high rates; overcharging will not harm the battery. Due to very low internal resistance, the T-Type Nicad battery has an exceptionally high ampere rate of discharge at useful voltage which is important in all engine starting applications. A charged battery, left on open circuit for long periods of time, will still deliver a major percentage of its capacity. Complete specifications and data on the long-life T-Type Nicad batery for railroads may be obtained by writing to DIESEL PROGRESS, File 76, P. O. Box 8458, Los Angeles 46, California.

Moves to New Building

Cummins Diesel Sales Corporation has leased the building at 3218 Lucas Avenue, St. Louis, Missouri, and moved from its old location. The new location, in addition to giving the sales and service agency 12,000 square feet of floor area, about twice the old, will be better adapted for the repair of diesel engines.

National Electric Creates New Region

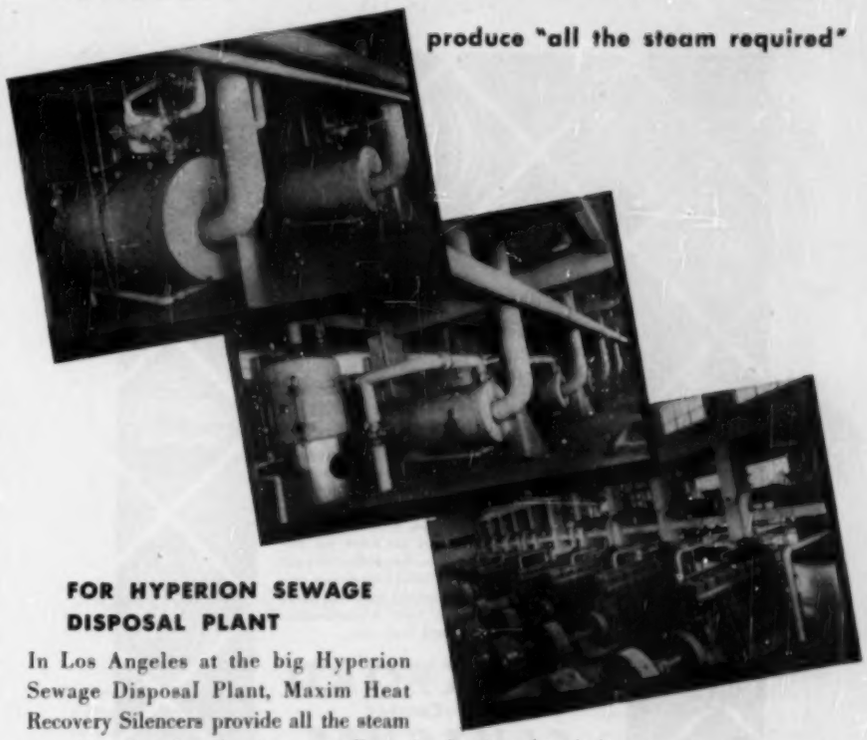
H. E. Colliver

National Electric Products Corp., Pittsburgh, has created within its sales organization a mideastern region and has named H. E. Colliver, the regional manager. The regional office is in the Enquirer Building, Cincinnati, Ohio. In making this sales territorial change, R. C. Bennett, Jr., vice president and sales manager, said the region was established to give customers a faster and more consolidated service. Mr. Colliver has been with National Electric since 1930. He joined the firm in that year as a territorial salesman in the Cincinnati area. In 1947 he was placed in charge of the company's sales of wire, conduit, cable and electrical roughing-in materials throughout Ohio. He is a past president of the Electric League of Cincinnati. The new mideastern region includes the territory covered by the National Electric sales offices in Cleveland and Cincinnati, Ohio, as well as in Detroit, Michigan, and Wheeling, West Virginia.

DIESEL ENGINE CATALOG is just off the press in its Fifteenth Edition. Completely revised and up-to-date, it is invaluable to design engineers and buyers. ORDER COUPON ON PAGE 25.

MAXIM HEAT RECOVERY SILENCERS

produce "all the steam required"



FOR HYPERION SEWAGE DISPOSAL PLANT

In Los Angeles at the big Hyperion Sewage Disposal Plant, Maxim Heat Recovery Silencers provide all the steam necessary for plant heating as well as for heating the sludge.

This outstanding installation highlights the practicality of Maxim Heat Recovery Silencers. Here is efficient use of waste exhaust heat that would otherwise just go "up the flue" to the outside atmosphere. The extra fuel cost for this usable heat is zero because the only fuel involved is that normally used for engine operation.

More and more industrial plants are combining effective silencing of engine exhaust with this efficient method of producing steam for heating or processing operations. Our Heat Recovery Silencer bulletin offered below gives details. Send for it today.

BE SURE IT'S A **MAXIM**

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THE MAXIM SILENCER COMPANY
94 HOMESTEAD AVE. HARTFORD, CONNECTICUT

Please send HEAT RECOVERY SILENCER bulletin.

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COMPANY_____
ADDRESS_____
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Sells Locomotive Division

H. K. Porter Company, Inc., recently announced the sale of its locomotive business, including patterns, drawings, and spare parts business, to Davenport-Besler Corporation (Davenport Locomotive Works), Davenport, Iowa. T. M. Evans, president of Porter, stated that the sale included an agreement that Davenport-Besler would service all Porter locomotives now in use. George Besler, chairman of Davenport-Besler, explained that Davenport will not only service all Porter locomotives now in operation, but will also build duplicate Porter locomotives, including the Porter fireless locomotives. This arrangement was made possible by including all drawings in the purchase.

Power Equipment Engines Put "In Mothballs" When Idle

Contractors, municipalities and highway departments can put their power equipment engines "in mothballs" during idle spells by methods developed for protection of military vehicles in storage, N. T. Brenner, chief fuels and lubricants engineer, tractor section, Gulf Oil Corporation, advises. Trucks, bulldozers, snowplows, fire engines, ambulances and other gasoline or diesel driven vehicles in intermittent use will benefit from these fully proven lay-up procedures, Mr. Brenner asserted.

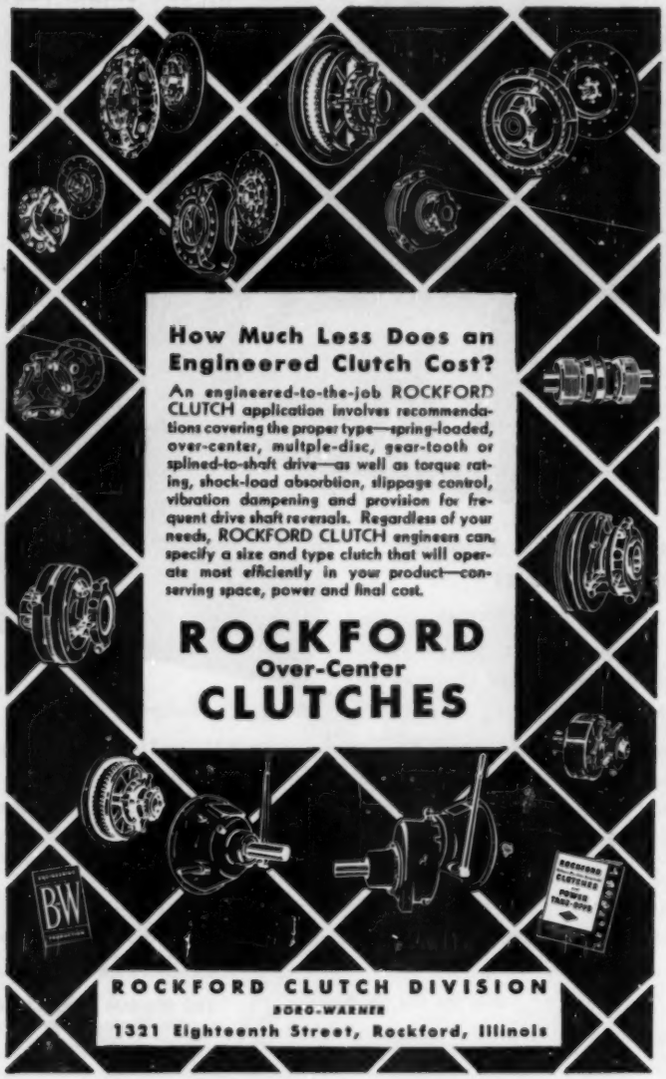
Life is lengthened, operation improved, and cleanliness of internal parts guarded. The necessity of overhaul to correct rusting and corrosion caused by temporary lay-up is eliminated.

This protective lay-away is made possible by special oils, such as Gulf No-Rust Engine Oil, Grades No. 1 and 2, created for military use in the past 10 years, but now commercially available, Mr. Brenner said. Application is simple and requires no special equipment. Here are directions he gives for best results with gasoline and diesel engines: Gasoline engines: drain crankcase when warm, fill to normal operating level with the protective oil, run engine 20 to 30 minutes at one-third to one-half normal operating speed. To protect cylinder walls, piston rings and valves, shut off the ignition, spray two ounces of the oil into each cylinder through the spark plug hole while rotating engine by hand or by the starter (at least five complete revolutions of the crankshaft). Apply oil to metal parts of spark plugs, including points and threads. Diesel engines: follow same procedure for crankcase as with gasoline engines. Remove fuel injectors where possible, and spray at least two ounces of no-rust oil into each cylinder to protect piston heads and valves. Rotate engine as recommended for gasoline engines. Apply oil to threads and bodies of injectors. Fuel system of all engines: remove as much fuel as possible from the tank and run the engine without load until it stops for lack of fuel. No fuel should be left in the fuel system during storage. Spray inside of tank and filler cap threads with protective oil. In addition, thoroughly lubricate engine accessories. Completely drain cooling system.

The company's no-rust oils meet U. S. Army requirements, which include: ability to protect against high humidity and moisture condensation, to neutralize acidic products of combustion, and to be a satisfactory lubricant for spark ignition and diesel internal combustion engines. In addition these oils must have no harmful effect on metals used in engine construction. Since the no-rust oils are formulated to serve for a considerable time in the place of regular lubricants, the engine may be run on the no-rust oil without drainage when it is taken out of storage, until convenient to change. Protective oils should also be applied to exposed engine metal, such as water pump shafts or places where paint has cracked off, to provide an anti-rust coating. The oil serves as an excellent general engine oil and as a protective lubricant for all tools and equipment subject to rust. Surfaces should be dried and the oil applied after use.

Appointment at General Electric

Frederick R. Cronmiller has been appointed supervisor of budgets and planning for the Chemical Department of the General Electric Company, it has been announced by H. P. Smith, comptroller. Formerly a staff industrial engineer for Stevenson, Jordan and Harrison, Inc., of New York City, Mr. Cronmiller has had a varied experience in the field of industrial accounting. He started his career in 1937 with Cheney Brothers of New York and later became associated with the American Safety Razor Corporation and Vita Var Corporation. Prior to his affiliation with Stevenson, Jordan and Harrison, he was with Continental Can Co. as a staff industrial accountant.


How Much Less Does an Engineered Clutch Cost?
An engineered-to-the-job ROCKFORD CLUTCH application involves recommendations covering the proper type—spring-loaded, over-center, multiple-disc, gear-tooth or splined-to-shaft drive—as well as torque rating, shock-load absorbtion, slippage control, vibration dampening and provision for frequent drive shaft reversals. Regardless of your needs, ROCKFORD CLUTCH engineers can specify a size and type clutch that will operate most efficiently in your product—conserving space, power and final cost.
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Appointments at Eaton Mfg. Co.

Robert F. Golden

C. A. Sellen

E. D. Cowlin, general manager of the Reliance Division of the Eaton Manufacturing Company, Massillon, Ohio, announces the appointment of Robert F. Golden as works manager for the Reliance Division and C. A. Sellen as assistant to the general manager. The rapid expansion of the company business and the need for a closer coordination between the plants is necessary; also greater cooperation for the superintendents, Mr. Arthur Cocklin, of Plant No. 2, and Mr. Frank Pflug, of Plant No. 1, plus the future planning for activities in the Reliance Division, are some of the reasons for these promotions.

Mr. Golden joined the Reliance Division in May of 1946 and has devoted his time to development and research until this promotion. Previous to his joining the Reliance Division, Mr. Golden was assistant to the president of The National Lock Washer Company at Newark, New Jersey, where he had been in succession factory manager of National's Newark, N. J., plant and steel mill at Riverside, N. J., and an engineer in the Merchants Mill of the Pennsylvania Steel Company (now Bethlehem Steel Company). Mr. Golden holds B.S. and M.E. degrees from Georgia Tech. Mr. C. A. Sellen joined the Reliance Division in September of 1939 as chief metallurgist. Previous to that he had been located in the Metallurgical Laboratory for the Canton-Massillon District of Republic Steel. He graduated from Ohio State University in 1929 with a degree in metallurgy. He also is a graduate from Washington High School with the class of 1924.

Electro Pressuregraph

A very useful folder has been received here in our editorial offices describing the Electro Pressuregraph, which claims to accurately measure and record the dynamic and static pressures and to provide complete pressure–time studies of internal combustion engines – compressors – injection pumps–pipelines. The equipment consists of an electronic pick-up which is connected to the region where the pressure is to be studied, an associated electronic circuit and power supply, and a cathode-ray oscilloscope. In actual use by a large number of industrial firms and universities, the Electro Pressuregraph has proved a very accurate and reliable instrument for measuring and recording dynamic, static and transient pressures. We suggest that, if you are interested in an instrument of this kind, you communicate with the Electro Products Laboratories, Inc., 4501 North Ravenswood Avenue, Chicago 40, Illinois.

Chicago & Eastern Illinois Orders Diesels and Freight Cars

Chicago and Eastern Illinois Railroad has ordered six 1,500-hp. general purpose diesel locomotives and 50 freight cars at a cost of approximately $1,225,000, Clair M. Roddewig, president, announced. The diesel order was placed with the Electro-Motive Division of the General Motors Corp. and was "necessitated by the increased volume of freight traffic during the past year," said Mr. Roddewig. The diesels, which will cost approximately $900,000, will be delivered in December and January. In addition to the diesels, 25 flat cars and 25 covered hopper cars have been ordered from the Thrall Car Co. of Chicago Heights. These will cost approximately $225,000, and delivery is expected in the first quarter of 1951. This railroad placed a similar order for cars with Thrall earlier this year.

Attend Meeting

Five members of the Stewart and Stevenson Services, Inc., sales organization, attended a meeting the week of October 22 at the Chrysler Corporation plant in Detroit. Following the Chrysler meeting, they made a tour of the General Motors Detroit Diesel Engine factory at Detroit. The men were Ray Loden, Houston; Emmett Dobbs, Houston; N. N. Elkins, Corpus Christi; J. C. Brown, McAllen; Casey Manning, Longview; and A. B. Grant, Beaumont.

BALBOA

Uncovered Half a World...

Vasco Nunez de Balboa blazed a path across Panama in 1517. He opened the way to the Pacific and a vast new world. But that, at the time, was not understood. So, finally, Balboa was executed.

PORUS-KROME* *Opens the Way to* ***MORE DIESEL ECONOMY!***

Diesel users are more appreciative of Porus-Krome than the Spanish king was of Balboa's discovery. But then, the king lacked facts by which to judge the value of what Balboa had done.

About Porus-Krome, of course, the facts are known. Now that Vanderloy M has been added, there is no excuse for scrapping *any* Diesel liner. That means, *all* your present liners can last indefinitely.

Gone are the costs of oversizing, of stocking, handling and storing oversize parts. No need for loss in engine availability, for lower combustion and lubrication efficiency resulting from *unprocessed* liners.

In the 10 years since Porus-Krome first proved its value, major Diesel users have shown increasing profits from this process. That's why they specify it in original equipment and use it 100 percent.

If *you* don't, it must be because you haven't the facts. Those facts are waiting for you. Get in touch with us today.

* * *

**PORUS-KROME is a dense, hard, wear and corrosion-resistant chromium, produced by the Van der Horst Corporation of America, and which gives working surfaces an infinite number of tiny oil-retaining reservoirs for perfected lubrication*

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U. S. PATENTS 2,048,378, 2,314,604 and 2,412,698

PORUS - KROME VAN DER HORST

Good for the Life of your Engines

COLUMBIA
GENERATORS
A.C. and D.C.

Columbia, with its years of experience, brings to you a wide line of performance proved, sturdily built, A.C. and D.C. Generators. A.C. Generators: 6¼ to 1000 KVA. D.C. Generators and Exciters: 2 to 300 KW. Available in Single or Two Bearing Construction. *Write today for information. Our engineers will be glad to review your requirements. Prompt delivery.*

COLUMBIA ELECTRIC MFG. CO.
4519 Hamilton Ave., Cleveland 14, Ohio

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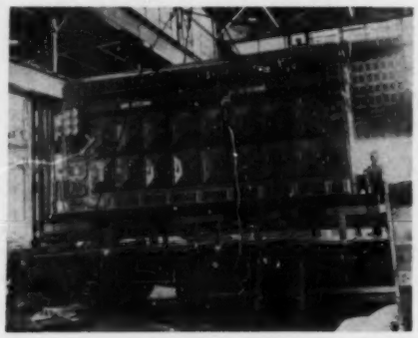
Complete Engineering Facilities Are at Your Service

Koppers has the largest modern, completely equipped piston ring plant in the world, manufacturing rings of all types, sizes and specifications for all makes and models of power equipment. Whatever your piston ring problem may be, we're equipped to help you solve it!

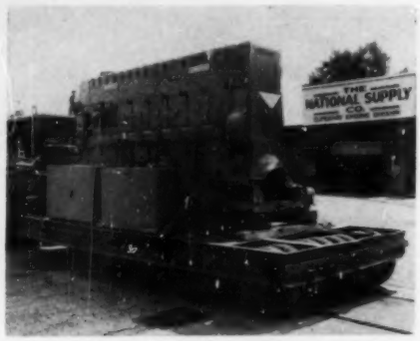
WRITE for information to KOPPERS CO., INC., Piston Ring Dept. 1632 Hamburg St. Baltimore 3, Md.

KOPPERS

Two New Installations for National Supply



Power for New York City's newest and largest sewage plant at Owl's Head Point, Brooklyn, will be supplied by six of these 1,300-hp. Superior diesel engines. The first one was loaded for shipment recently from Springfield, Ohio, by The National Supply Company's Engine Division. For economy of operation, the New York Department of Public Works has selected engines that will use either oil or sewage gas as fuel. Engines run also with both fuels together. Each engine will drive 900-kw. generators which will provide electric power for the new plant. Contamination of beaches will be greatly reduced by next season when the plant will be treating approximately one-sixth of New York's estimated billion gallons of sewage daily.



Headed for Burnips, Michigan, where it will take its place beside three other Superior engines in a power plant there, is this 8-cylinder Superior supercharged dual fuel diesel unit. Located between Grand Rapids and Lake Michigan, the engine installation at Burnips had been comprised of three Model 160 Superior diesel engines, two of which were dual fuel units. Operating records of the Wolverine Electric Coop., owners of the engines, have indicated very favorable results, and recently the above unit was ordered to supplement existing power facilities.

Sinclair Refining Company Holds Educational Regional Conference

On October 12th, Sinclair Refining Company acted as host to more than 75 scientists, engineers and college professors at its Research and Development Laboratory in Harvey, Illinois. This was the first of a series of one day educational regional conferences sponsored by the Diesel Engine Manufacturer's Association, which will be held throughout the country.

The purpose of the meeting was to exchange ideas between mechanical engineering professors, particularly those interested in diesel engine design and operation, with the Sinclair staff and each other. The agenda provided for a tour of Sinclair's analytical laboratory and engine laboratory. During the day there were technical talks by Sinclair engineers on the development of diesel lubricants and diesel fuels directed toward improving the performance of the diesel engine. There was also an interesting talk on educational requirements for engineering research workers. In addition to professors of the following schools, there was in attendance representatives of diesel manufacturing and affiliated companies from the Chicigo area: Illinois Institute of Technology, Northwestern University, University of Illinois, Evansville College, Purdue University, Tri-State College, Rose Polytechnic College, University of Notre Dame, Iowa State College, State University of Iowa, Marquette University and the University of Wisconsin.

The object of these meetings is to provide practical aides to professors in classroom administration. The chairman of the program was Walter G. Ainsley, of the Sinclair Research and Development Laboratory.

Catalog — Volume Fifteen

The 15th volume of the DIESEL ENGINE CATALOG is now available to the industry. A complete revision of volume fourteen, with many new engines, many new models, many old models re-rated. In this volume fifteen you will find every diesel engine, every dual-fuel engine and every natural gas engine actively manufactured and sold in these United States, technically and completely described and illustrated. Plus a large and very important accessory equipment section. Truly described as the Bible of the industry, this volume fifteen of the DIESEL ENGINE CATALOG can be obtained by mailing $10.00 to DIESEL PROGRESS, P. O. Box 8458, Los Angeles 46, California.

Performance depends on PERFECT CONTROL

For your automatic engine . . . SYNCHRO-START CONTROLS are unequalled in performance, economy, safety, dependability and protection.

Eighteen years of manufacturing controls, ranging from a simple switch to multiple engine control panels, have given SYNCHRO-START the "know-how" to make a thoroughly DEPENDABLE CONTROL.

When you order your engines — SPECIFY SYNCHRO-START controls. Your manufacturer, dealer, engineering firm, or architect can furnish you with the correct control. Or write us direct.

SYNCHRO-START PRODUCTS, INC.
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New Jersey Turnpike

An Allis-Chalmers HD-19 crawler pushes work on the New Jersey Turnpike by spreading a sand blanket over the marshy approaches to the north bank of the Raritan River near New Brunswick, New Jersey. After a Lorain dragline casts top silt away from the approach area, the HD-19 bulldozes and levels the sand. After this basic foundation is completed, earthen fill will be added to give body and sufficient height to the right of way in case of flood conditions along the river banks. Contractors on the job are Angelo and George Villa, who run the Villa Contracting Company. In the background dredges are making preparations for an $850,000 bridge.

The estimated engineering and construction cost of the 118-mile stretch of superhighway, including the cost of acquired real estate for the right of way, is now set at $183,925,000. Approximately 70 Allis-Chalmers HD-19 crawlers have already joined the fleets of construction equipment assigned to this tremendous job. Each of these tractors is powered by a 6-cylinder G. M. diesel 2-cycle engine. The working season of 1950 will be devoted primarily to grading, excavating, heavy earthmoving, drainage and major foundation construction. The working season of 1951 will begin paving operations, construction of bridge superstructures and minor features. Easy curves, long sight distances and minimum grades throughout (no grade will be more than 3 per cent), will make the highway a super-safeway, assuring users the safest of driving conditions at speeds to be established by the Turnpike Authority.

Baldwin Locomotive Receives Orders

The Baldwin Locomotive Works has announced the receipt of orders from the French North African Railway delegation in the U. S. A. for six all-service diesel-electric locomotives, including two of 1,500-hp. for The Moroccan Railroads, and four of 1,600-hp. for The Algerian Railroads. The Moroccan locomotives will be sandproofed for severe desert conditions. Both of these railroads have been using Baldwin diesel-electrics since the end of World War II.

Worthington Vice President

Austin C. Ross

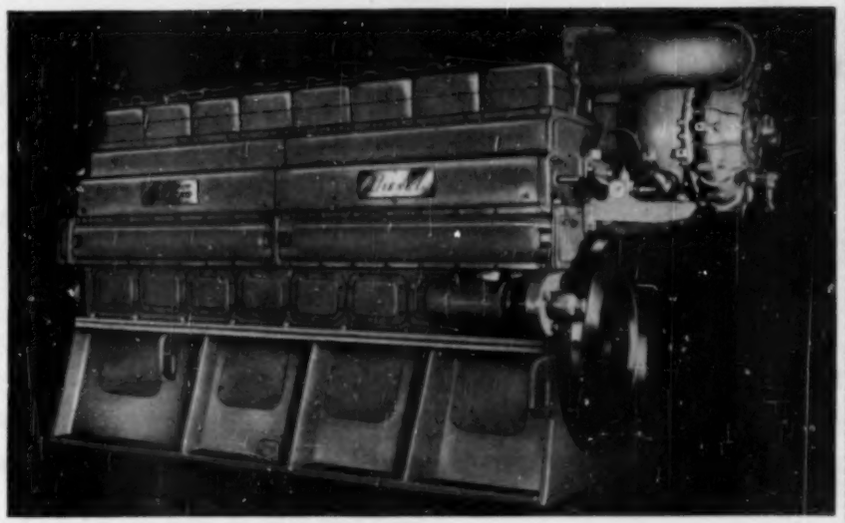
Austin C. Ross, manager of the Buffalo works of Worthington Pump and Machinery Corporation, has been elected a vice president of that company at a recent meeting of the board of directors, according to an announcement by H. C. Ramsey, president. Ross will continue to serve as Buffalo works manager, the announcement continued. Ross joined Worthington in 1932 as assistant general purchasing agent, became assistant works manager of the Buffalo works in 1935 and works manager in 1940. He is a graduate of Toronto University, where he obtained his Bachelor of Applied Science in electrical engineering in 1915. From 1919 to 1931 he was associated with Rolls-Royce of America, Inc., in Springfield, Mass. A director of the Buffalo Chamber of Commerce, Ross is also a member of The New York State Society of Professional Engineers, Buffalo Athletic Club, The Buffalo Club, and University Lodge A. F. & A. M.

DIESEL ENGINE CATALOG is just off the press in its Fifteenth Edition. Completely revised and up-to-date, it is invaluable to design engineers and buyers.

More POWER... *Less* SPACE

WITH

STERLING VIKING DIESELS



This 8-cylinder turbo-supercharged Viking Diesel is conservatively rated at 750 hp. Sterling Diesels are available in five different models beginning at 100 hp.

DIESEL POWER
for all
INDUSTRY

AUTOMATIC POWER PLANTS
DRILLING RIGS — HOISTS
LOCOMOTIVES — PIPE LINES
GENERATOR SETS
FISHING CRAFT — DREDGES
LIFT BRIDGES — TOW BOATS
COMPRESSORS — AIRPORTS
VENTILATING SYSTEMS
PUMPING STATIONS
SHOVELS

Sterling Viking Diesel engines offer definite advantages in:

Compactness . . . more power in less space. A high ratio of horsepower to weight.

Sturdy construction . . . one piece block and base. All working parts are easily accessible.

Dependability . . . Service records show a high operating efficiency, low maintenance cost. All Sterling Diesels are conservatively rated, built to deliver smooth performance over their full power range.

Without cost or obligation, talk over your power requirements with an **experienced** Sterling engineer. We invite your call and the opportunity to bring you up to date on Sterling's accomplishments.

STERLING ENGINE COMPANY

1270 Niagara St. Telephone Lincoln 0382 Buffalo 13, N. Y.

Sterling Viking Diesel Engines from 100 to 750 hp.—Sterling Gasoline & Gas Engines from 100 to 600 hp.

New Division Established by Weatherhead

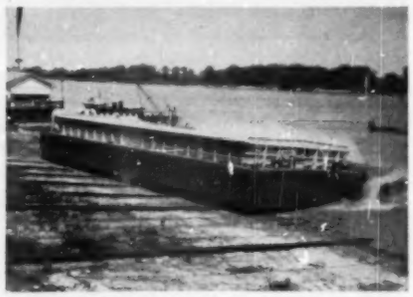
A. D. Hodge

Albert J. Weatherhead, Jr., president of The Weatherhead Company, Cleveland, Ohio, has announced the appointment of A. D. (Andy) Hodge as sales manager of the company's newly formed industrial sales division. A carefully planned sales and service program has been formulated for the new division handling the complete Weatherhead industrial line: (1) high-quality hose and reusable steel hose ends (a full line in all sizes and pressures is offered); (2) Ermeto fittings in steel, stainless steel and brass; and (3) standard SAE flare, compression, inverted flare, threaded sleeve and pipe fittings (available in brass). Under the new program, Weatherhead industrial salesmen are strategically located in key cities to render the most efficient service possible and to establish closer contact with Weatherhead accounts from coast to coast. A special educational plan directed by Weatherhead factory trained sales and service engineers has also been included to acquaint distributor and jobber salesmen with all details of the Weatherhead line.

A pioneer in the research which led to the development of the all-steel reusable hose end connection and many other new devices, The Weatherhead Company has served the nation with high-quality products for over thirty years. Well known for its progresive policy, the company was the first to use extrusions for brass fittings and also introduced the now famous Ermeto fitting to United States industry. The Weatherhead Company has published three catalogs covering: Industrial Fittings (Cat. No. F-1456); Hose and Reusable Hose Ends (Cat. No. H-1451); and Ermeto Fittings (Cat. No. E-1457). They are available upon written request.

Inland Waterways Corporation Barges

The St. Louis Shipbuilding & Steel Co. is just completing at its St. Louis Yard 12 series-D barges for the Inland Waterways Corporation. These house type barges, with rolling covers, of all steel construction, have a hull molded size 123 feet 9 inches long by 54 feet wide by 11 feet deep. They are approved and certificated by the American Bureau of Shipping for dry cargo service. At 9-foot draft each barge can carry 1,400 tons of cargo. These barges were specially designed for a particular service of the Federal Barge Lines and are to be towed by their newest motor vessel, the *Harry Truman*. They are square on both ends so that they will fit into fully integrated tows, but can be dropped out of the tow at any terminal for loading or unloading. The bow and stern of each barge is fitted with a plug and socket type interlock as well as two 15-ton hand powered winches to assist in making up the tow.



Each barge has two complete pumping systems of long coupled centrifugal pumps, driven by a direct connected ball bearing 7½-hp., 220-volt, weatherproof, alternating current motor. The pumps are located adjacent to the deckhouse ends and are sufficiently high to drain all piping leading to them. This installation enables any barge, since they are of the double skin type with ballast tanks between the shells, to be raised or lowered to meet the prevailing draft of the tow. The deckhouses are approximately 7 feet 3 inches high, with rolling, watertight hatch covers to protect the cargo from damage. On both sides of the top of each house, parallel to the cover rails, is a steel grating walkway 15 inches wide, with a ladder to the main deck at each corner. Ladders from the deckhouse combing to the cargo deck are provided in diagonal corners. As fast as these barges are launched and completed, the Federal Barge Line is placing them in use in its newly inaugurated express service between New Orleans, St. Louis and Chicago.

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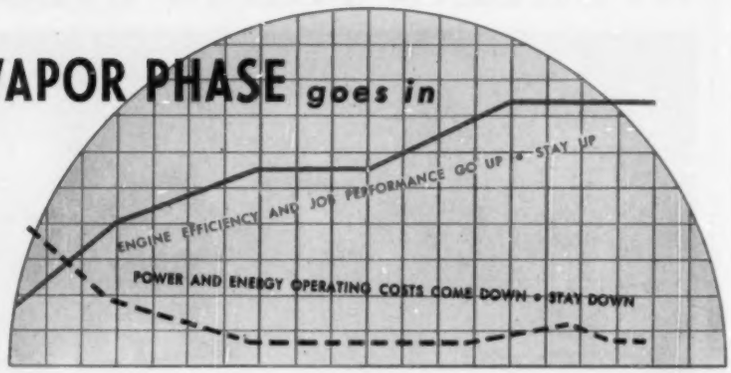
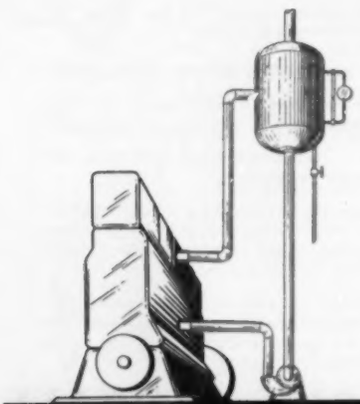


Before you buy an engine or make costly power changes, learn what Vapor Phase will do — what it will SAVE you!



Modern Vapor Phase, now serving more than 30 different types of old and new engines of all sizes, on thousands of varied jobs, is the *proven lowest cost system* in every way—first cost, operation and savings accrued.

Vapor Phase reduces engine operating costs to a new low—provides record engine efficiency unaffected by ambient temperatures or conditions—doubles and trebles engine life.

—Permits use of low-cost engine fuels, even untreated acid fuels, without harmful effect,

—Eliminates need for expensive boilers, heaters, heat exchangers, troublesome fans, belts, radiators or costly cooling towers, upon which your requirements may now depend.

AND THAT'S NOT ALL!

Vapor Phase equipped engines *also* serve the multi-purpose job of generating steam, heating water, fluids, space or other process (including cooling or heating through air conditioning systems)—each as required or all at the same time, for the cost of engine operation *only*. Imagine the saving!

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And more 200 h.p. model NH-600 Cummins Diesels are being delivered in new heavy-duty highway trucks than any other engine—**gasoline or Diesel!**

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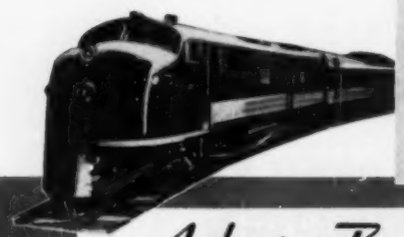
Diesel Industry acclaims JOHNSON SLEEVE BEARINGS

The constantly increasing business placed by the diesel industry, the new giant in industrial America, is loud praise for Johnson Bearings. Wherever diesels are at work, on the highway, the farm, the rails, the sea or in industry, a large proportion of them are equipped with sleeve bearings from Johnson Bronze. The quality, the precision and the dependability of Johnson Bearings are responsible for such wide acceptance.



JOHNSON ENGINEERS

will gladly study your diesel requirements and make recommendations on type and design of bearings needed. Write, wire or call for an appointment.

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C. L. (Pat) Foy

At the Fourth Annual Protective Packaging and Materials Handling Competition conducted by the Society of Industrial Packaging and Materials Handling Engineers at Philadelphia on October 10th to 12th, Detroit Diesel Engine Division of General Motors took two first prizes in the six packaging classifications and "honorable mention" for the second best inner pack in the show. This is believed to be the first time any concern has won two first prizes in this competition. C. L. Foy, in charge of package design at Detroit Diesel, submitted three entries in the competition. The two winning entries were a Fuel Injector Package and Cylinder Kit Package, scientifically tested cartons for precision-built, carefully finished vital engine parts. Developed by years of successive improvements, ingenious arrangements of corrugated fibreboard inserts and padding and oil proof paper, resulted in packages that are smaller in size, lighter in weight, less expensive and have virtually eliminated shipping damage.

Features of the Fuel Injector Package include reusability, yet a string-breakable tape seal is immediate evidence as to whether the package contains a new part from the factory or a used or rebuilt part. On this package an attractive full scale photographic reproduction of the injector identifies the contents. This is unique in this industry. The Cylinder Kit Package offers a heretofore unattained measure of protection for piston rings which are exceedingly vulnerable to breakage through distortion if not carefully handled. The Cylinder Kit Package, besides winning first prize in Group 1 (Corrugated or Solid Fibre Boxes), was awarded an "honorable mention" as being next to the best "inner pack" in the show.

New Cylinder Kit package, open and closed.

The Cylinder Kit Package contains all necessary parts for complete diesel engine cylinder overhaul including a cylinder liner, piston, piston pin, retainers, and a complete set of piston rings. The combined weight of the cylinder liner, piston, piston pin and retainers is 14 lbs. 8 ozs., concentrated in an area of approximately 292 cu. in., and it presented a serious packaging problem due to the vulnerability to damage of the piston rings. This weight must be kept away from the rings and through 4 years of experience and tests the Detroit Deisel Engine Division found that the new method is the best practical way of packaging

this kit. In this 4-year period, G.M. tried many methods and materials, including additional corrugated board fillers, solid wood blocking, hardwood dowels, and ¼-inch plywood. In all of these tests it was proved that shock and/or impact to the piston rings must be held to an absolute minimum to insure proper ring protection.

In the former package they placed the rings in the top section of the package, protected by a 600-lb. test corrugated tray resting on a 200-lb. test corrugated inner sleeve. For further protection, they anchored the piston and piston pin on the bottom of the package by means of a piece of wood extending through the portholes of the liner and across the top of the piston. The liner assembly was oil dipped and wrapped in a grease-proof paper prior to placing in the carton.

The new package, however, differs materially, the rings are placed on the side protected by a special corrugated pad and it will be noted that the ring carton fits snugly at its sides along the pads and the carton wall—they allowed approximately ⅛-inch space in the depth for more "give" in the cushioning effect. The rings are further protected by a corner insert which fits between the cylinder liner and ring protector and tends to hold the weight away from the rings. Note the space allowed here for further cushioning. A spiral wound paper tube, wax coated, is used only to immobilize the piston within the liner. It should be noted that all materials touching the parts are non-corrosive, grease-proof lined. This eliminates the necessity of wrapping the parts, which are coated with a Navy Grade II preservative.

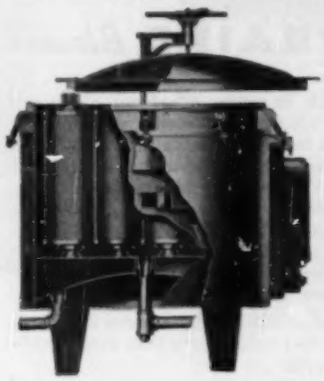
Prize-winning Cylinder Kit package showing contents in "exploded" arrangement.

Recapitulating the advantages of the new package over the old—there is a 6 per cent reduction in cube, a 14.5 per cent reduction in costs; and total elimination of damage complaints on shipment of over 100,000 of the new packages.

On the fuel injector package, the old container was a kraft folding carton with lock type tucks, primarily designed for merchandising and customer protection. As in the new package, a wax-coated spiral wound tube was used to suspend the injector tip. A wax coated corrugated board, size 27x4 inches, with nine scores and two die cut holes, folded around the assembly, holding the tube in position. A wax lined corrugated board sleeve fitted over the folded insert, forming a container

Less time for a change!

HOFFMAN Cartridge Filters



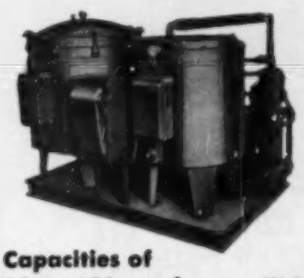
Simplify Cartridge Replacement with Exclusive Cover-Lifting Device

Along with efficient filtering at high flow rates, Hoffman Cartridge Filters provide maximum service convenience. Exclusive cover-lifting device speeds up cartridge change — either the 7 x 18 size, for Navy throw-away cartridges, or the 11 x 18, for repackable or throw-away types, offer this feature. Swing bolts fasten the cover — an additional advantage for cartridge changes.

FOR LUBRICATING, FUEL OR INDUSTRIAL OILS

Two sizes: I-718 for 7 x 18 Navy-size throw-away cartridges in multiples of 1, 2, 4, 7, 9, 14, and 18 cartridges. I-1118 series, for either repackable or throw-away cartridges, in multiples of 1, 2, 3, 4, 6, and 8 cartridges.

Write for bulletins A-703 and A-649 respectively.



Complete Recovery of Used Oil

—The HOFFMAN OIL CONDITIONER

Removes insolubles, as well as solubles, to cut new oil costs. Unit consists of Hoffman Vaporizer (to remove oil, gas, moisture and fuel dilution) . . . Cartridge Filter to remove solubles. Mounted on a common base . . . only 2 moving parts . . . no steam or water connections.

Capacities of 50 to 600 g.p.h.

Write for Bulletin A-667 and A-668

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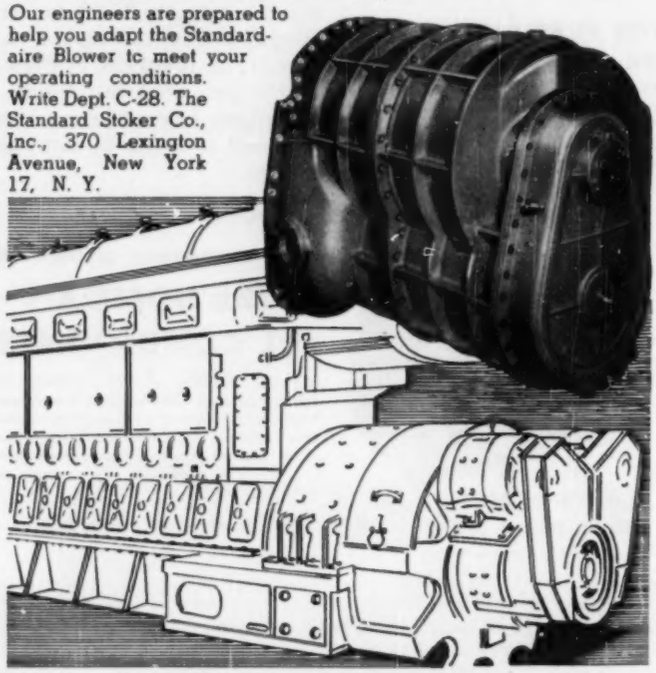
The Standardaire Blower with its unique features of design assures outstanding operating results whether for diesel service or for its many industrial applications. Service tested Standardaire Blowers have proved they operate with exceptionally high adiabatic and mechanical efficiencies at greatly reduced blower horsepower requirements. Their "air screw action" also eliminates shock delivery of air. This feature combined with high adiabatic efficiency means a relatively cooler discharge air temperature, resulting in increased cylinder charge density for a given cylinder volume and pressure. The net gain — greater horsepower per pound from your diesel engine.

Another feature—*lower noise level.* Unbiased tests prove Standardaire Blowers have 8 to 15 decibels lower noise rating than comparable blowers of the positive displacement type.

Our engineers are prepared to help you adapt the Standardaire Blower tc meet your operating conditions. Write Dept. C-28. The Standard Stoker Co., Inc., 370 Lexington Avenue, New York 17, N. Y.



THE STANDARD STOKER CO • INC •

Standard Stoker SSS

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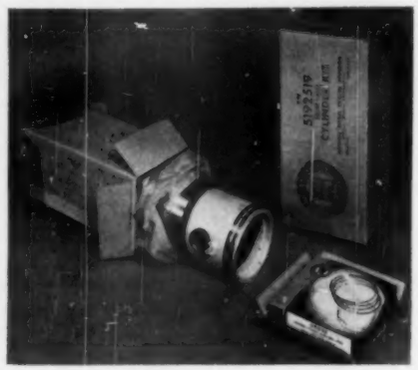
for inter plant shipments. This unit also served as a container for reconditioned injectors.

The new package for the injectors is a convolute wound, telescope style, fibre can with lacquered metal ends. The walls are lined with a non-corrosive grease-proof parchment type paper which has an excellent resistance to the free oil. This is a dirt-proof, tamper-proof package with a string opening feature. This type of opening destroys only part of the label without otherwise weakening the container. It therefore leaves a highly reusable package, but with the label partially destroyed it is readily identified as a used item. When used as a package for reconditioned injectors, it is sealed at the string line with printed pressure-sensitive tape, readily identifying it as used and sealing it from dirt.



Former Cylinder Kit package in which the piston rings were packaged at the top and which required an oil-proof paper inner wrapping.

Completed prize-winning Injector package and contents ready to package.

To center and hold the assembly in position is a V-3 corrugated board with two die cut holes, which is fitted over the injector nut and small dowel with the edges firmly against the walls of the container, thus preventing the assembly from twisting and turning. This also supports the walls, giving good protection to the rack. Note that the only sections of the rack touching any part of the package are the ends. The wax coated fibre tube for tip protection is designed primarily to hold the tip in a floating position. It also serves to hold the middle insert in place. Then the plunger spring protector is a die cut-scored 200-lb. test corrugated board with a non-corrosive, grease-proof lining. The fitting of this insert along the side of the spring down to the injector nut helps to eliminate heavy compression of the

YOUNG "HC" HORIZONTAL CORE

ECONOMY PLUS VERSATILITY IN

WATER, OIL, GAS COOLING... STEAM & VAPOR CONDENSING

Basic "HC" Unit may be used in multiples for greater cooling capacity or combination of services.

IMPORTANT FACTS ABOUT THE "HC"

- LOW COST—small initial investment, economical maintenance.
- VERTICAL AIR DISCHARGE—eliminates cross wind effects.
- HIGHLY EFFICIENT—airfoil section fan.
- MULTIPLE INSTALLATIONS—provide greater capacity, combined services.
- NO VIBRATION—adjustable pitch fan mounted separately from unit.
- LARGE CAPACITY—water cooling, from 600,000 Btu/hr up; oil cooling, from 20,000 Btu/hr up.
- LOW HP REQUIREMENT—1 to 10 hp per fan.
- EASY INSTALLATION—simplified piping and frame construction.
- CORE GUARD SCREEN—protects cores from falling objects.

• Here is another development by Young providing high efficiency cooling and condensing at low initial and operating costs. The Dual coil "HC" is designed for water and lube oil cooling. Manifolds are available for all types of coils. Four sizes, with 2, 4, 6 and 8 coil installations, provide exceptional versatility in heat transfer service. The 4 or 6 blade fan, serving each two coil unit, may be mounted directly on the fan motor shaft, or powered by a v-belt or gear speed reducer drive. Full details about the new "HC" Units, or other Young Heat Transfer Products, are available on request.

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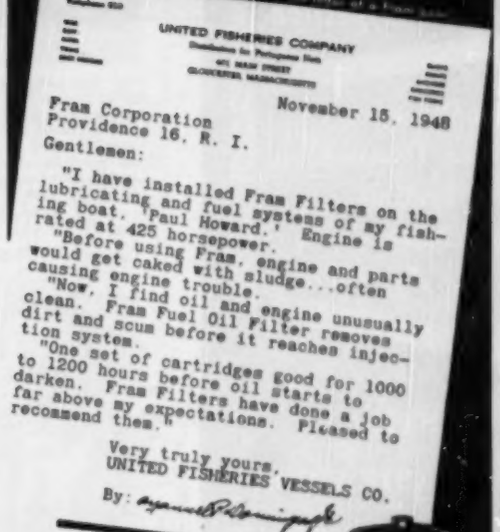
Here's how FRAM FILTERS can save you money . . .



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November 18, 1948

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"Before using Fram, engine and parts would get caked with sludge...often causing engine trouble.

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No matter what your Diesel oil filtering problem—fuel or lube—Fram can help you conquer it. Let Fram's Research Department help you by determining what Fram Filcron Oil Filter you need for keeping injectors clean and efficient . . . keeping vital moving parts free from the damage caused by dirt, dust, grit, sludge and abrasives.

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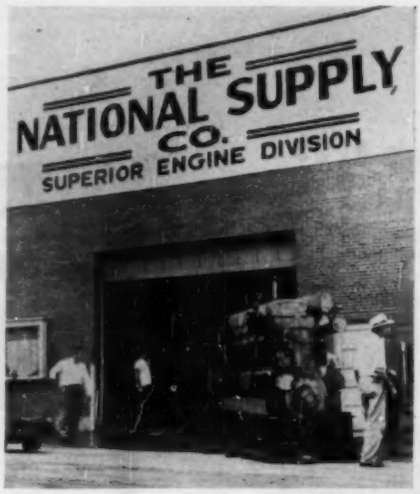


The first complete engine from the Atlas Imperial Diesel Engine Company Oakland, California, is shown here arriving at The National Supply Company's Engine Division at Springfield Ohio. National Supply recently added to its horsepower range of diesels with the purchase of the assets of Atlas Imperial. The company will manufacture, sell and service Atlas engines and parts in addition to its line of Superior diesel, gas and dual-fuel engines.

Executive Changes at Caterpillar

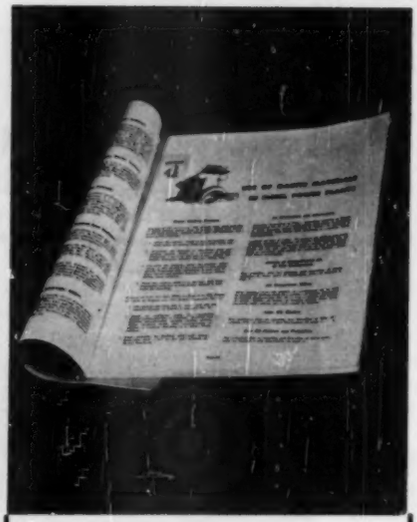
E. W. Jackson

Harmon S. Eberhard

Broadening of the executive structure of Caterpillar Tractor Co. has been announced by Louis B. Neumiller, president of the company, the change including creation of an additional executive vice presidency and promotion of four administrative and departmental heads. Harmon S. Eberhard, vice presidence since 1942, has been named executive vice president to share with Executive Vice President A. T. Brown and Mr. Neumiller increasing responsibilities of top administration. William Blackie, vice president since 1944, in addition to other duties, will coordinate with Caterpillar's Peoria, Illinois, plant, administration of the San Leandro, California, and Joliet, Illinois, plants, and Caterpillar Tractor Co. Ltd., new British subsidiary.

E. W. Jackson, director of parts and service since 1947, and Ralph M. Monk, director of industrial relations since 1938, have been named vice presidents. W. H. Franklin, controller since 1944, has been given additional administrative direction, and A. N. Whitlock, assistant controller since 1948, assumes direct supervising of accounting.

DIESEL ENGINE CATALOG is just off the press in its Fifteenth Edition. Completely revised and up-to-date, it is invaluable to design engineers and buyers. ORDER COUPON ON PAGE 25.



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tells how to speed
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THIS illustrated digest contains a wealth of sound, practical ideas to expedite Diesel maintenance and keep operating costs low. Gives details on such subjects as:

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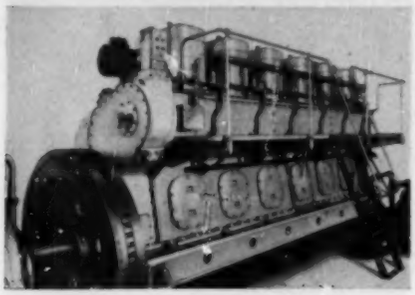
New Baldwin Diesel Engine



A new series of diesel engines, ranging in capacity from 700 to 2,080 bhp., is announced by The Baldwin Locomotive Works. Designated as the Series 700, these engines are 4-cycle, 17-inch bore, 20-inch stroke, with speeds of 257 to 375 rpm. They are available with six and eight cylinders, normally aspirated or supercharged. The engine is intended primarily for stationary service such as electric power generator drive, pumping service on oil or gas pipe lines, municipal water pumping service, and other stationary power services. However, it is also well suited for diesel-electric main propulsion drive and direct reversing propulsion drive in marine service.

The new engine was designed to replace the Baldwin Model VM and VG engines, and to increase the power range while at the same time reducing the size and weight per horsepower. Welded construction of bedplate, frame and cylinder housing is a leading factor in this modernization program. Another feature of the new design is the use of double wall cylinder liners with individual water jackets, thus eliminating internal water seals. Uniform liner temperatures are effected by the high velocity of the cooling water through the liner jackets. The jacket is designed to carry cooling water above the top piston ring to obtain maximum cooling efficiency. Four accessible water jumpers conduct the water from each cylinder liner to each cylinder head. The crankshaft is a steel forging supported in precision-type bearing shells and bearings that may be removed for inspection through frame openings without disturbing the crankshaft. Complete inclosure of moving parts provides easy access to all engine parts.

The combustion chamber is of the open type, thus giving exceptionally smooth operation and fuel consumption. Cylinder heads are individual castings having two exhaust valves, two air intake valves, and fuel injectors in the center. Valve mechanism is inclosed by aluminum covers. Individual fuel injection pumps serve each cylinder, with spring-loaded multi-hole type injectors. Fuel is supplied to injection pumps under pressure from a small gear-type pump at the free end of the engine. Exhaust and air intake headers are of welded construction and are so arranged that exhaust and air intake pipes may be connected at either end of the engine. The exhaust header is water jacketed.

Lubrication is provided under pressure by a positive displacement gear pump, the oil supply being contained in the bedplate. Lubricating oil for priming is circulated by a motor-driven pump. The engine is arranged for air starting, using cam-operated air starting check valves on each cylinder. A governor of the hydraulic relay type and an overspeed stop of centrifugal trip type are gear-driven from the camshaft. More than two years of performance tests and field service show the new engine to be an efficient and economical addition to the Baldwin line.

Engineering Manager for Koppers Piston Rings

Appointment of A. H. Engstrom as acting engineering manager for American Hammered Piston Rings manufactured by the Metal Products Division of Koppers Company, Inc., was announced recently by Walter F. Perkins, vice president and general manager of the Koppers Division. Mr. Engstrom formerly was assistant to the manager of the American Hammered Piston Ring engineering and research department, Dr. Tracy Jarrett, who resigned because of ill health. A native of Duluth, Minn., Mr. Engstrom received a Bachelor of Science degree in mechanical engineering from the University of Southern California. Before joining Koppers in February, 1950, he was in charge of diesel production, testing and service for Continental Motors in Muskegon, Mich. He also was previously associated with Tri-State Railways in Detroit, Michigan, as a diesel technician.

DIESEL ENGINE CATALOG is just off the press in its Fifteenth Edition. Completely revised and up-to-date, it is invaluable to design engineers and buyers. ORDER COUPON ON PAGE 25.

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Transport operators all over the world have learnt to trust this sign.

In any language the letters on the C.A.V. sign stand for first-rate service facilities, maintained by highly-trained craftsmen, using special precision equipment.

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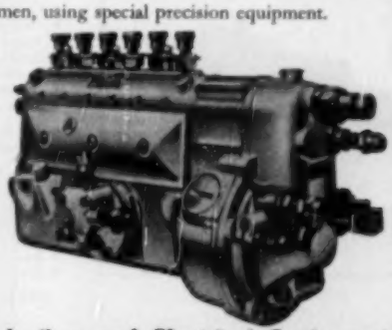

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Meters the precise amount of oil needed.
Frees manpower for more productive jobs.
Reaches vital parts ordinary methods can't lubricate.
Gives each wearing point a full-time 'oiler'.

Manufacturers using Manzel Lubricators report that they save their initial cost many times over in reduced labor cost, lower oil consumption, and fewer breakdowns. "Manzels" are standard equipment on many makes of engines, pumps, compressors, hydraulic presses, conveyors, and other machinery. Or...you can install them on present equipment.

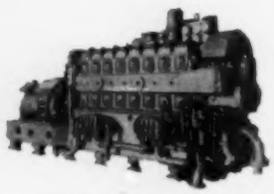
Manzel representatives will gladly supply technical assistance on lubrication problems.

Manzel
Division of
FRONTIER INDUSTRIES INC.
275 BABCOCK ST.
BUFFALO, N. Y.

A. C. Power PLUS ! ! *when you use this*

Generate your own A.C. power at the lowest possible cost. Reduce your operating expenses — now — with this outstanding diesel generator set.

200 K.W. G.M. 8-268A DIESEL GENERATOR SET



Unit mounted on welded steel base with spring isolators

A.C. GENERATOR — WESTINGHOUSE

- *Voltage — 440 volts — 3 phase*
- *Power Factor — 80%*
- *Frequency — 60 cycles*
- *Speed — 1200 r.p.m.*
- *Duty — Continuous*
- *Excitation — D.C. exciter*
- *Degree of enclosure — Open — dust-proof*
- *Method of cooling — Self ventilated*

D.C. EXCITER — WESTINGHOUSE

- *Voltage — 120 volts*
- *Amperes — 333*

ENGINE — G.M. 8-268A — 8 CYLINDERS

- *Nominal H.P.—450*
- *Air starting*
- *Bore—6½"*
- *Stroke 7"*
- *Speed—1200 r.p.m.*
- *Cooling—heat exchanger*

WEIGHT OF GENERATOR SET — 16,705 LBS.

WRITE — PHONE — WIRE MARINE DEPARTMENT

The BOSTON METALS Co.

313 East Baltimore St.
Lexington 1900

Baltimore, Maryland
Curtis 5050

Former Injector package. Note larger size, greater bulk of inserts and lack of re-usability as compared to new package.

spring. In fitting from corner to corner and along two walls of the container, it further helps in preventing the twisting and turning of the assembly. When the lid is seamed on, it fits snugly against this top insert, finalizing the immobilization of the assembly. This new package, the result of two years' research, accomplished the following: a 17.1 per cent reduction in cube; a 5.9 per cent reduction in weight; an 18.5 per cent reduction in packaging costs; giving a masterful merchandising and tamper-proof package.

W. T. Crowe (right), general manager of Detroit Diesel Engine Division, congratulates C. L. Foy (left) and J. Ball, parts manager, on winning two first prizes and an honorable mention in a national competition of industrial packaging engineers.

This fuel injector assembly, so packaged, is considered the heart of the General Motors diesel engine and receives a prominent place in their merchandising program. This assembly is made up of highly precisioned parts, some of which are as closely precisioned as parts in a fine watch, and is preserved with an inhibited oil of light viscosity. The irregular shape of this assembly and the fact that it must be suspended for proper protection to its exposed parts, was a problem in itself. However, it was important that the package offer much more than protection. It must have high merchandising value, a good re-usable value and, to a large extent, be able to retain the light free oil which drains from the unit.

Your editor has given an extensive description to these two packages, both the new one and the old one, because the handling of diesel engine replacement parts has become a very vital problem to all of us in this industry and we thought our readers would benefit materially from a detailed discription of how one manufacturer has solved the problem.

Champion Driver Wins Trophy

John H. Castner, champion driver for Pierce Auto Freight Lines, of Medford, Oregon, again won the truck-full trailer section of the 1950 National Truck Roadeo held during the 17th Annual American Trucking Associations, Inc., Convention in New York City. His second consecutive victory in this classification allows Castner to retain for another year the Cummins trophy, which has been awarded the winner of this classification at every national "roadeo" since 1940. Castner also moved closer toward permanent possession of the trophy, which requires only three victories in the national contest for drivers. He won the 1949 event, held last year in Phoenix, Arizona. The huge victory cup, standing four feet high, is awarded each year by Cummins Engine Company, Inc., to inspire greater skill and safety in the operation of heavy-duty trucks. The winner also receives a miniature replica of the trophy to keep permanently.

Advertising Agency Man Goes to Cooper-Bessemer

Richard E. Hoierman

The Cooper-Bessemer Corporation have just engaged the services of Richard E. Hoierman. Formerly production manager for Morgan Advertising Agency of Mansfield, Ohio, Mr. Hoierman is now associated with E. R. Bonnist, Director of Advertising for Cooper-Bessemer. A graduate of Maimi University, Mr. Hoierman became a student in the merchandising and advertising training program at the Westinghouse Electric Company, Mansfield, Ohio.

Catalog — Volume Fifteen

The 15th volume of the DIESEL ENGINE CATALOG is now available to the industry. A complete revision of volume fourteen, with many new engines, many new models, many old models re-rated. In this volume fifteen you will find every diesel engine, every dual-fuel engine and every natural gas engine actively manufactured and sold in these United States, technically and completely described and illustrated. Plus a large and very important accessory equipment section. Truly described as the Bible of the industry, this volume fifteen of the DIESEL ENGINE CATALOG can be obtained by mailing $10.00 to DIESEL PROGRESS, P. O. Box 8458, Los Angeles 46, California.

TAKE THE "EAT" out of VALVE SEATS

GRIND THEM TRUER- GRIND THEM FASTER-

with the

WATERBURY-HALL
DIESEL TYPE
Valve Seat GRINDER

Model EDP Diesel Type Eccentric Valve Seat Grinder. Range of surface seats: 2½ to 6½". Equipped with two grinding wheel adapters.

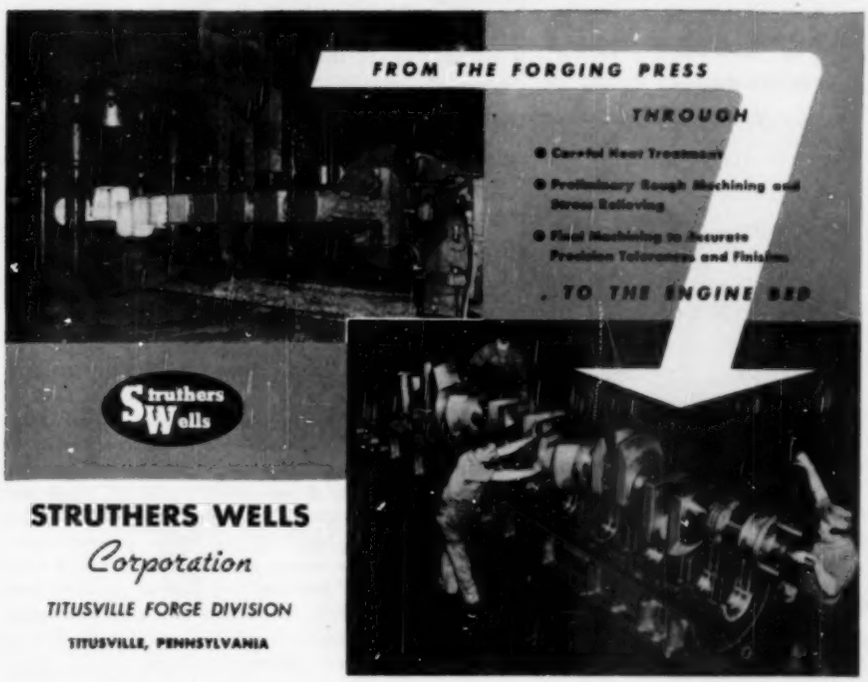
Engine performance is improved and stays improved for longer periods. Fuel economy is renewed. Valve seat grinding takes less time, and it's done right. These are the advantages of the Waterbury-Hall Valve Seat Grinder. Any mechanic can use it to produce a factory true job. Manhours mean more with

WATERBURY-HALL
Precision-Built
PERFORMANCE

• WRITE FOR DESCRIPTIVE BULLETIN

WATERBURY TOOL DIVISION
VICKERS, INCORPORATED
A SUBSIDIARY OF THE SPERRY CORPORATION
WATERBURY 91, CONNECTICUT

TITUSVILLE—a dependable source for FORGED CRANKSHAFTS


FROM THE FORGING PRESS
THROUGH
• Careful Heat Treatment
• Preliminary Rough Machining and Stress Relieving
• Final Machining to Accurate Precision Tolerances and Finishes
TO THE ENGINE BED

Struthers Wells

STRUTHERS WELLS
Corporation
TITUSVILLE FORGE DIVISION
TITUSVILLE, PENNSYLVANIA

THOMAS
Flexible ALL METAL
COUPLINGS
FOR POWER TRANSMISSION
REQUIRE NO MAINTENANCE

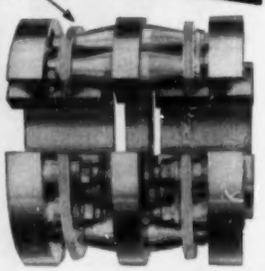
Patented Flexible Disc Rings of special steel transmit the power and provide for misalignment and end float.

Thomas Couplings have a wide range of speeds, horsepower and shaft sizes:
½ to 40,000 HP
1 to 30,000 RPM

Specialists on Couplings for more than 30 years

BACKLASH
FRICTION
WEAR and
CROSS-PULL
are eliminated
Lubrication is not required!

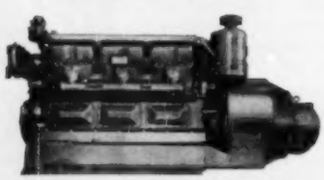
PATENTED FLEXIBLE DISCS



THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT.

NO MAINTENANCE PROBLEMS.

ALL PARTS ARE SOLIDLY BOLTED TOGETHER.



FOR SUCH TOUGH JOBS AS: DIESEL COMPRESSOR DRIVES, MARINE MAIN DRIVES, LOCOMOTIVE MAIN DRIVES, AUXILIARY DRIVES, ETC.

Write for the latest reprint of our Engineering Catalog.

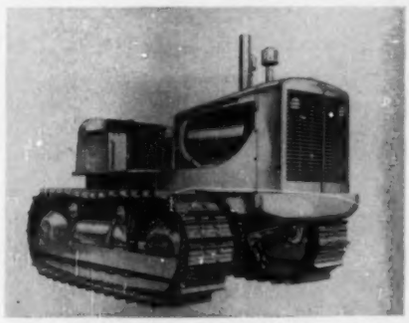
THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA

New Proto Hex Sockets

Addition of twenty single-hexagon (6-point) thin-wall socket wrenches to the Proto line has been announced by H. D. Norton, new products manager of the Plomb Tool Company. Having thin walls, these sockets can be used in restricted areas—wherever corresponding double-hexagon (12-point) types will fit. Although thinner than regular power sockets ,the new designs are guaranteed for power or hand use in service work.

Single hexagon sockets are particularly useful because they safely fit and turn undersize nuts, as well as those that are rusted or damaged. They permit safe work on stubborn nuts without danger of slipping, and they do not chew up brass or other soft nuts. Hex sockets are stronger than 12-point types and therefore wear longer. The sockets are made of special alloy steel that also adds to their life. They have a lustrous chrome finish to match other Proto sockets and attachments. Seven of the twenty additions are three-eighths inch drive regular sockets with openings of five-sixteenths inches to eleven-sixteenths inches. Six are three-eighths inch drive extra deep sockets with three-eighths inches to eleven-sixteenths inches openings. Seven are one-half inch drive regular sockets wtih three-eighths inches to three-fourths inches openings. Further information may be obtained by writing to DIESEL PROGRESS, File 75, P. O. Box 8458, Los Angeles 46, California.

New HD-19 Pusher



A new pusher for use with the Allis-Chalmers HD-19 tractor has been announced by The Baker Manufacturing Company, Springfield, Illinois. Available as a complete unit or as an attachment, the new Baker pusher weighs approximately 725 pounds complete, is heavily reinforced, sturdily constructed and designed to work with practically all types of scraper push plates. The new pusher floats with the pusher block of the scraper, whether it be high on a fill or low in a deep cut.

Caterpillar Appointments

J. R. Munro

J. R. Munro, a native of San Leandro, California, has been named to the newly created position of director of manufacturing of Caterpillar Tractor Co., San Leandro and Peoria, Illinois, it is announced by H. S. Eberhard, vice president. Munro joined Caterpillar as an apprentice in San Leandro in 1918. He went to Peoria in 1931 and became assistant superintendent of engine and tractor assembly two years later. In 1934 he became superintendent of diesel engine assembly and testing, in 1936 he was made factory manager of the entire tractor and engine division, and in 1942 became general factory manager. C. A. Woodley, assistant general factory manager since 1945, has been named general factory manager, W. L. Naumann and Lloyd J. Ely became assistant general factory managers.

Koehring Twinbatch Pavers

The Koss Construction Company of Des Moines, Iowa, recently reported a fine production record with their two Koehring 34-E Twinbatch pavers, both of which were powered with 4-cylinder General Motors diesel engines. On 22 miles of U. S. Route 81 in Kansas, these two fast batching Koehring pavers poured 2,800 feet of 22-foot pavement in one 10-hour run. The slab was a uniform 9 inches in thickness, mesh reinforced. In another period of four consecutive days, Koss' crews poured 2 full miles to complete the entire 285,000 square yards—a 22-mile paving project—in just 12 calendar weeks. Records show these crews consistently poured over 1,000 batches per 10-hour day—one day 1,238 batches were poured for a tota lof 6,844 square yards.

Lister-Blacktone Acquires Show Window Premises

Show window premises in the Grand Central Terminal District of New York City have been acquired by Lister-Blackstone, Inc., manufacturers of diesel engines, it was announced recently by Walter K. Davies, president. The new premises, located at 49 Vanderbilt Avenue, will supplement the company's executive offices at 420 Lexington Avenue, New York, and will be used for displaying latest models of the company's line of diesel engines, generators and marine auxiliary units. In addition, maintenance and spare parts service for the greater New York area will be handled out of the new premises.

ATLANTIC METAL HOSE GUARDS DIESEL LIFELINES

air
fuel
water
exhaust

Typical Double Insulated Exhaust Hose

Write for Diesel Bulletins 1020 and 50A.

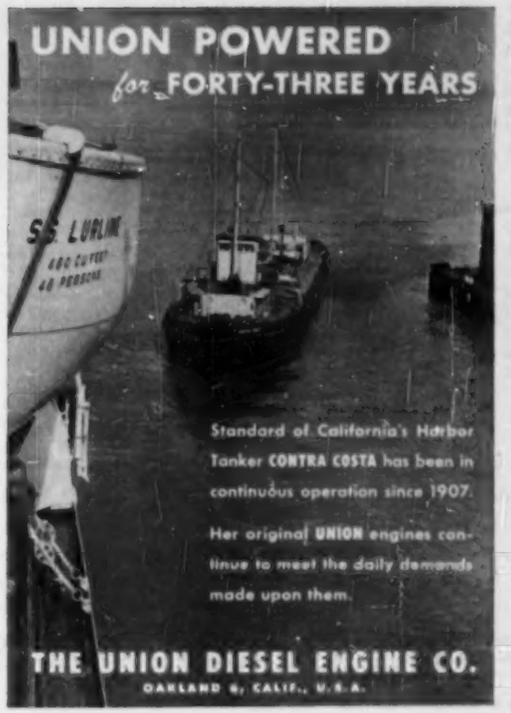
•

See our Catalog in Sweet's File for Product Designers.

ATLANTIC flexible metal hose does a **better** job of controlling vibration of these vital lines and insuring their continuous, trouble free operation—because each section is **Job Tested and Guaranteed to Do Its Job!**

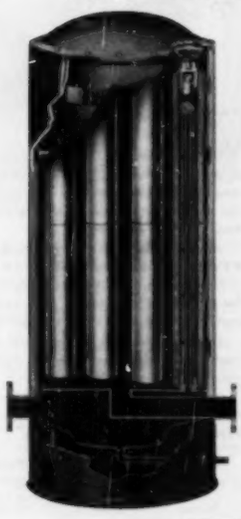
That's why more and more purchase requisitions read, "Order from Atlantic for **Every** Diesel Need!" Furnished in all workable metals—¼"-36" I.D. inclusive . . . with fittings as desired.

ATLANTIC METAL HOSE CO., INC.
102 West 64th St. New York 23, N. Y.


UNION POWERED
for FORTY-THREE YEARS
SS LURLINE
Standard of California's Harbor Tanker CONTRA COSTA has been in continuous operation since 1907.
Her original UNION engines continue to meet the daily demands made upon them.
THE UNION DIESEL ENGINE CO.
OAKLAND 6, CALIF., U.S.A.

HONAN-CRANE Oil Purification offers 3 types of interchangeable CARTRIDGE REFILLS

for correct handling of every purification problem

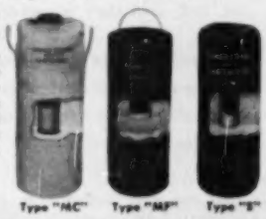


Three types of cartridge refills, designed by Honan-Crane especially for Honan-Crane purifiers, make it possible for you to select the filtering medium best suited to your purification needs. Cartridges are interchangeable and may be used to remove either solids or products of oxidation . . . maintaining any oil in approximately new condition.

Easy-to-handle Honan-Crane refill cartridges are your assurance of thorough oil purification at lowest cost.

Honan-Crane Type "M" Continuous Oil Purifier

Multiple-cartridge purifier, available in eleven sizes using 1 to 24 cartriages. Provides high flow rate and is designed to use easy-to-change "MC", "MF", or "S" type cartridges.



Type "MC" Type "MF" Type "S"

Honan-Crane Type "MC" Cartridge

"MC" Cartridge is a woven cotton bag containing 15 pounds of Cranite (specially processed fullers earth). Solids and abrasives as well as soluble products of oxidation such as asphaltenes, resins and acids are removed from the oil.

Honan-Crane Type "MF" Cartridge

"MF" Cartridge is a perforated metal basket lined with a woven cotton sock material and uniformly packed with Pulcania (specially selected cellulose fiber filtering medium). Complete removal of solids such as abrasives, scale and other foreign matter.

Honan-Crane Type "S" Cartridge

Type "S" Cartridge contains 4½ pounds of Pulcania tightly packed in a specially woven cotton sock material. Performance of the cartridge is comparable to the "MF" cartridge in removal of abrasives, scale and other foreign solids.

Write for descriptive bulletins covering Honan-Crane Oil Purification Equipment for Diesel Lube and Fuel Oils, Turbine Oils, Cutting Oils, Quench Oils, Coolants, etc. State type of purification problem.

HONAN-CRANE CORPORATION
307 INDIANAPOLIS AVE. LEBANON, INDIANA
A Subsidiary of **HOUDAILLE-HERSHEY CORP.**

SAVE $ $ $ — LARGE VOLUME, SMALL PROFIT

Lot No.	Quantity	Size	Manufacturer	Model	Condition	Price Each
1	2	500 H.P.	Cleve. Div.	8-268A	Rebuilt	$ 5,995
2	2	500 H.P.	Cleve. Div.	8-268A	Guaranteed	6,995
3	2	900 H.P.	G. M.	12-567	Rebuilt	7,995
4	2	1600 H.P.	F-M	38D818	Rebuilt	15,595
5	1	200 H.P.	Graymarine	671	Rebuilt	1,295
6	5	225 H.P.	G. M.	671	Used	2,695
7	4	1750 H.P.	G. M.	258S	Used	Consider
8	4	1800 H.P.	Hamilton	99DA	Used	Your Offer

SPECIAL POWER PLANTS — 10 K.W. to 1000 K.W. — AC and DC

Lot No.	Quantity	Size	Current	Make	Model	Condition	Price Each
9	5	20 KW	DC	G.M.	271	Used	$ 1,595
10	2	20 KW	DC	G.M.	271	Rebuilt	1,895
11	4	30 KW	AC & DC	G.M.	371	Used	1,795
12	2	30 KW	AC & DC	G.M.	371	Rebuilt	1,999
13	2	60 KW	DC or AC	G.M.	671	Rebuilt	2,150
14	2	60 KW	DC or AC	G.M.	671	New	3,195
15	1	25 KW	DC	F-M	36A	Rebuilt	1,595
16	1	20 KW	DC	Hill		Rebuilt	1,395

Lot No. 17: New Twin Disc Clutch 1:5 to1, $295; 2:1 to 1..... 395

Lot No. 18: Spare Parts for G.M. 671, 271, 371, 258's, 3-268A, 8-268A.

Lot No. 19: EXCELLENT Patrol Craft Ship with G.M. Engines, All Steel, 172 ft.

WE ARE IN THE MARKET FOR 20, 30 KW G.M. UNITS AND ALL TYPES OF EQUIPMENT

LARGE VOLUME, SMALL PROFIT — PHONE — WIRE — WRITE

F.O.B. WEST COAST — SPECIAL TERMS; FOR CASH — EXPORT ORDERS: U. S. DOLLARS.

COMMISSIONS: Will Protect You on Any Overages Added on These Prices.

The Above Quotations Are Subject to Prior Sale, Final Confirmation, and Price Change

BUY TODAY! AT OUR LOW PRICES! SELL TOMORROW, GET HIGHER PRICES, AND BE ABLE TO DELIVER.

DUnkirk 2-4046
(24-Hour Service)

GUS KONUGRES & CO.

Cable Address: "Guskongres"

SHIP AND POWER EQUIPMENT

Ship Breaking • Repairing • Building • Brokering • L.S.M. • Patrol Craft • S.C. • L.C.I. • L.S.T. • Yachts

2033 WEST SEVENTH STREET — LOS ANGELES 5, CALIFORNIA

Young "A-800" Heat Exchangers

Announcement was made recently by the Young Radiator Company of Racine, Wisconsin, and Mattoon, Illinois, that specially designed "A-800" shell and tube bundle heat exchangers have been developed for oil cooling in diesel locomotive, diesel engine, gasoline engine, and similar applications. They are standardized in manufacture for prompt delivery and minimum cost. They are said to be engineered to provide high cooling capacity within a light-weight, compact shell. The manufacturer states that "A-800" units are well suited for use with engine jacket water as the coolant, maintaining a balanced temperature between oil and water when required. The Young-designed bonnets provide smooth inlet and outlet flow with a minimum impact on headers and are removable for ease in cleaning. Tubes are secured into the headers to prevent leakage from vibration and temperature changes. Full details are given in Bulletin Form 1250, recently released and may be obtained by writing to Young Radiator Company, Racine, Wisconsin.

NEED TRAINED DIESEL MEN?

Hemphill graduates have received broad, practical training in the operation, maintenance, and servicing of diesel engines.

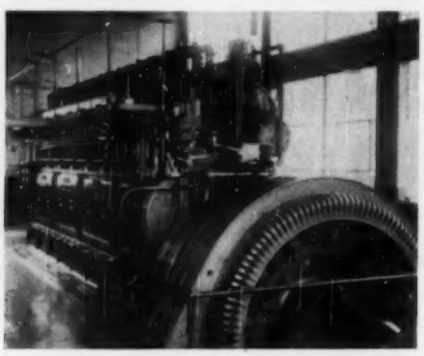
On your job they can save you money, and make you money.

GET THE KIND OF DIESEL MEN YOU NEED FROM

HEMPHILL SCHOOLS, INC.

New York
31-28 Queens Blvd.
Long Island City 1, N. Y.

Memphis
311 South Main St.
Memphis 3, Tenn.



INVESTIGATE

. . . the city officials of Horton, Kansas, did, and they learned:

The savings *more than justified* converting the 1,000 H.P. Worthington Type EE engine (shown above) to dual fuel.

If you are now using only oil for fuel and have natural gas available, write today for our service plan.

DIESEL MODIFICATION, INC.
114 S. Elgin — Phone 5-5050
TULSA, OKLA.

What a WHALE of a saving Mechanized Cleaning Means to Diesel Shops!

WHEN stubbornly carbonized diesel parts are cleaned in Magnus Aja-Dip Machines, with Magnus 755 as the cleaner, you can turn out in ½ to 2 hours (depending on the parts being cleaned*) what ordinary cleaning methods take 1 to 4 hours to do.

At the same time you get much better cleaning, with 95% of all hand work eliminated. The cleaning solution lasts many times longer than any other available cleaner for carbonized oil deposits. In fact, your cleaning materials costs would be reduced by at least 50%.

Operators of 60% of the diesel horsepower on Class 1 roads are using the Magnus Aja-Dip-755 method for cleaning their diesel parts.

It seems logical to suggest that you take a long and careful look at the Magnus method from the viewpoint of YOUR diesel cleaning operations.

Cleaning Time When Magnus 755 and the Magnus Aja-Dip Machine Are Used:

Heads	1½ hours	Pistons	20 minutes
Liners	2 hours	Blowers	20 minutes
Rods	20 minutes	Valves	15 minutes
		Strainers	10 minutes

MAGNUS CHEMICAL CO. • 85 South Ave., Garwood, N. J.
IN CANADA—MAGNUS CHEMICALS, LTD., MONTREAL
Service representatives in principal cities

Magnus
CLEANERS • EQUIPMENT • METHODS

designed for carefree performance...

That's why it pays to specify

TUTHILL

GENERAL PURPOSE PUMPS

• Low first cost • Negligible maintenance • Compact design • Operates dependably in either direction of rotation • Capacities to 200 g.p.m. • Pressures to 100 p.s.i. • Direct drive, slow-speed V-belt units and stripped models

Write for Model C bulletin.

TUTHILL PUMP COMPANY
939 East 95th Street · Chicago 19, Illinois · Phone RE 4-7420

NEW Sheppard DIESEL INDUSTRIAL TRACTORS

Sheppard Diesels, with their rugged, heavy-duty construction, are ideal for use with a hydraulic front end loader.

Four models . . . 7 power sizes

Wherever quantities of material are moved by loader, blade or trailer, a Sheppard Diesel's 75% fuel cost savings can mean the difference between profit or loss on the operation. A Sheppard Diesel's extra lugging power is especially desirable when heavy loads must be moved up steep inclines or over soft, heavy footing. Arc welders, compressors, pumps and other similar equipment can be built integral with a Sheppard to provide a compact, self-propelled unit.

Cut Fuel Costs ON MATERIAL HANDLING Over 75%

Mail today for full information

SHEPPARD DIESELS • HANOVER, PA.

I am interested in a Sheppard Diesel Tractor for

Name

Address

DEALERS: Write for complete details on the profitable Sheppard Diesel Franchise plan.

DIESEL'S THE POWER . . . SHEPPARD'S THE DIESEL

Reiner

EQUIPMENT THAT'S Right ON THE JOB!

Another example of Reiner built-for-the-purpose equipment is this mobile gasoline-driven pump built for the Brooklyn Highway and Sewer Department.

- **Reiner equipment is made in a wide range of sizes and types. It includes portable and stationary gasoline, gas and diesel driven generators, pumps and compressors.**
- **Reiner equipment is engineered to give full economy, efficiency and dependability in operation.**
- **Reiner's 25 years' experience and worldwide reputation for quality materials and expert workmanship assures you of the very latest in technical design and engineering.**

FREE BULLETINS *on standard units sent on request. Write today, stating your requirements.*

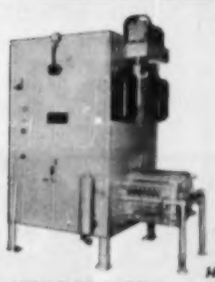
JOHN Reiner COMPANY
DEPT. 51, 12-12 37TH AVENUE
LONG ISLAND CITY 1, N. Y.
Cable Address: REINERINC

FOR CLEAN OIL and CLEAN ENGINES

HILCO

OIL PURIFICATION EQUIPMENT

PURIFIERS · FILTERS · RECLAIMERS · CONDITIONERS



AIRLINE OIL PURIFIER

HYFLOW OIL FILTERS

OIL RECLAIMER

There's a HILCO for every engine lubrication and fuel oil Purifying Problem

Before You Buy or Specify write for FREE literature

THE HILLIARD CORPORATION
122 W. Fourth Street, Elmira, New York

In Canada: UPTON-BRADSEN-JAMES, Limited
990 Bay St. Toronto · **3464 Park Ave. Montreal**

NEEDS NO SEALING COMPOUND

UNBRAKO

DRYSEAL

THREAD

PRESSURE PLUG

. . . seals pressure-tight without the use of sealing compounds. Features the "Dryseal" Pipe Thread originally developed for use with SO_2, ammonia, and other refrigerants. Offers a valuable solution to leakage problems in high pressure equipment of all kinds.

Unique design of the "Dryseal" Thread provides actual crushing and sealing at both major and minor diameters, effectively preventing spiral leakage, even under extreme pressures.

Incorporates all the important features of the regular UNBRAKO Pressure Plug, including fully formed threads, uniform taper and perfect roundness.

A full range of sizes from 1/16" to 1¼", National Pipe Thread Fuel, is available. Full details are given in Bulletin 675.

OVER 47 YEARS IN BUSINESS

STANDARD PRESSED STEEL CO.

JENKINTOWN 7, PENNSYLVANIA

DIESEL ELECTRIC POWER

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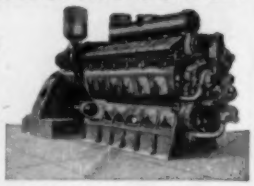
Unit Capacities 10 to 1875 Kva A.C. 50-60 Cycles Various Voltages



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West Coast Diesel News

By FRED M. BURT

SOLD to E. Edmonson & Son, Los Angeles contractor, a 135-hp. Murphy diesel to re-power an 80-D, North West shovel, by Engine Sales & Service, Los Angeles. Shovel used in rock quarry supplying rock for new San Diego jetty.

A THREE weeks' trip calling on distributors in the Gulf States and Caribbean areas by W. D. Brumbach, vice president in charge of sales, Hallet Mfg. Co., Inglewood, Calif., indicated extensive acceptance of the Hallet 5-hp. air-cooled, 1-cyl., diesel for auxiliary use on commercial fishing boats.

DISTRIBUTOR for Atlas Imperial diesels and sub-agent for "Caterpillar" diesels, Proveedora de Buques, S. de R. L., Guaymas, the Mexican West Coast's largest ship chandler, is establishing a branch at Mazatlan.

SUPPLIED by Bethlehem Supply Co., Los Angeles, to Richfield Oil Co., for use in Cuyamas oil field in the San Joaquin Valley, a Hopper well-servicing hoist powered with a 165-hp. G.M. diesel with a 28-hp. Waukesha diesel direct-connected to a Worthington air compressor for the air tongs.

SUPPLIED by Engine Sales & Service, Los Angeles, to Godfrey Drilling Co., Long Beach, a 2-cyl., 35-hp. P & H diesel to power a pump on a rotary water well drilling rig.

UNDER construction by Genoa Boat Works, Fisherman's Wharf, San Francisco, for Phillip Alioto, a 34-foot combination boat powered with 165-hp. General Motors diesel from Shore Line Maintenance Co., San Francisco.

FOR RE-POWERING a Pioneer portable hot-mixing plant by R. P. Shea Co., Indio, Calif., contractors, a Cummins diesel, 275-hp., purchased from Cummins Service & Sales, Los Angeles.

FROM CUMMINS Service & Sales, Los Angeles, a 100-kw. diesel-generating set for the new Psychopathic addition to the Los Angeles County General Hospital. The Allis-Chalmers generator is powered with an NH Cummins, 6-cyl. industrial diesel.

A new 165-hp. Murphy diesel supplied to B. & C. Lumber Co., Mojave, Calif., by Engine Sales & Service, Los Angeles, for lumber mill power, is hooked to two 56-inch saws, cutting 25,000 feet of pine lumber daily.

UNDER CONSTRUCTION at the Construcciones Navales yard, Guaymas, Mexico, five 66x18-foot wood shrimp trawlers, to be powered with 110-hp. Atlas diesels; three for Pesquera de Topolobampo, two for Alberto Tirado, Jr.

RECENTLY INSTALLED by Evans Engine & Equipment Co., Seattle, for re-powering, a new 3-cyl., 83-hp. General Motors diesel in the troller *Deutz*, owned by Bjarne Nilsen, Westport, Wash., fisherman.

POWERED BY Model 129, 4-cyl., 30-hp. Pacific diesel, new Monterey type fishing boat, the 30-foot *San Antonio*, owner Nick Trevisani, San Diego. Pacific diesel Model 265, 60-hp., for 36-foot fan tail commercial fishing boat, *Miss California*, built by Rask Boat Bldg. Co., Coronado, Calif.

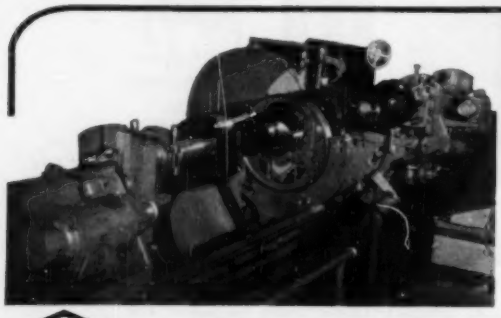
NEW PURSE seiner *Corsair*, length 78 feet, 110-ton capacity, powered with a 6-cyl Pacific diesel, Model 1905, 250-hp., owned by Paul Petricich, Tony Tomich, Andrew Vilicich, and Louis Ursich, covered measured nautical mile in 6 min., 6 sec., for a speed of 9.84 knots, stop watch time.

A 70-HP. P. & H. diesel from Engine Sales & Service, Los Angeles, for Bennett Lumber Co., Posey, Calif., powering two 48-inch saws in lumber mill, cutting pine for box material for Bakersfield Box Company.

DISTRIBUTOR for Atlas Imperial diesels and sub-agent for Caterpillar diesels, Proveedora de Buques, S. de R. L. Guaymas, the Mexican West Coast's largest ship chandler, has established a branch at Mazatlan.

UNDER CONSTRUCTION by Genoa Boat Works, Fisherman's Wharf, San Francisco, a 34-foot combination boat for Phillip Alioto, powered with a 165-hp. General Motors diesel from Shore Line Maintenance Co. San Francisco.

THE *RECRUIT*, Captain Martin Nilsen, San Pedro, now fishing with her new Model L6, 300-



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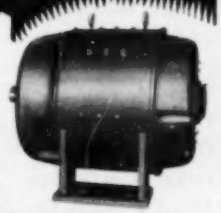
AC DC KURZ & ROOT GENERATORS



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.....and AC motors and motor generator sets

hp. Union diesel engine; Paul Allen, Union diesel service engineer, assisted with the installation in Seattle.

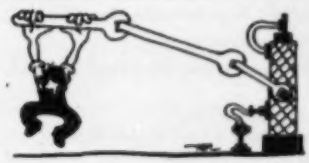
FOR CONTINENTAL Oil Co., Sussex, Wyo., oil field, a new Waukesha 300-hp. natural gas engine driving 200-kw. generator to supplement three 180-hp. Clark gas engines driving 125-kw. generators. With four condensers, the engines are hooked to a central Vapor Phase unit used as the cooling system; in the winter the steam produced by the Vapor Phase unit is used for heating.

A HOPPER well-servicing hoist powered with a 165-hp. General Motors diesel, also having a 28-hp. Waukesha diesel direct-connected to a Worthington compressor for the air tings recently supplied by Bethlehem Supply Co. to Richfield Oil Co. for use in new Cuyamas oil field, San Joaquin Valley.

BUILT IN Sagstad yard, Seattle, combination halibut boat and purse seiner, 57-foot *Pamela Rae*, owner Magnus Marten, is powered with a 165-hp. General Motors diesel from Evans Engine & Equipment Co., Seattle, also with 4.38:1 Twin Disc reduction gear.

AMONG THE many shrimp trawlers being constructed for Mexican waters, seven of 54-foot length powered by Washington and Atlas diesels, by National Steel & Shipbuilding Co., San Diego; two for Drake & Bullen, marine equipment dealers and Mexican suppliers, San Diego, at Birchfield Boiler Yard, Tacoma, powered with 90-hp. Washington diesels, with 2-cyl. Hercules combina-

THE NEW Pacific Gas & Electric natural gas line from New Mexico to the California Bay area, at the Kettleman Hills compressor station, has installed four No. 123-KVG-2, 1,320-hp. Ingersoll-Rand compressor units with natural gas engines; also four 1,760-hp. Clark gas engine driven compressor units—8-cyl. engines, 2-cycle, 300-rpm.



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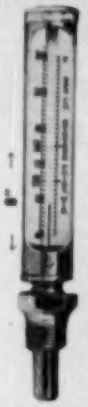

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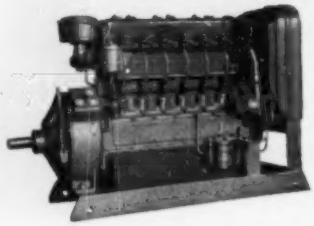

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ADVERTISERS' INDEX

ABOE, Inc. 30
Adeco Products, Inc. 95
Aerofin Corporation 95
Aeroquip Corporation 6
American Bosch Corporation 4
Atlantic Metal Hose Co., Inc. 91

Bacharach Industrial Instrument Co. 72
Boston Metals Co., The 88
Buda Company, The 16
Burmeister & Wain 69

C.A.V. Ltd. 87
Cities Service Oil Co. 71
Cleveland Diesel Engine Div., General Motors Corp. 7
Columbia Electric Mfg. Co. 78
Cooper-Bessemer Corp. ..... Fourth Cover
Crofton Diesel Engine Co., Inc. 95
Cummins Engine Co. 81

DeLaval Separator Co., The 13
Delco-Remy Div., General Motors Corp. 3
Detroit Diesel Engine Div., General Motors Corp. 29
Diesel Modification, Inc. 92
Diesel Plant Specialties Co. 95
Dy-Chek Co., Division of Northrop Aircraft, Inc. 86

Elliott Company ..... Third Cover
Engineering Controls, Inc. 80
Enterprise Engine and Machinery Co. 2
Erie Forge Co. 28

Federal-Mogul Corp. 10
Fitzgerald Manufacturing Co., The 96
Fram Corporation 85
Fulton Iron Works Company 32

General Motors Corp.
Cleveland Diesel Engine Div. 7
Delco-Remy Div. 3
Detroit Diesel Engine Div. 29
Harrison Radiator Div. 18
Gulf Oil Corp. 19
Guth Company 94

Harrison Radiator Div., General Motors Corp. 18
Hemphill Schools, Inc. 92
Hill Diesel Engine Co. 96
Hilliard Corporation, The 93
Honan-Crane Corp. 91

Illinois Testing Laboratories, Inc. 20

Johnson Bronze Co. 82

Konugres & Co., Gus 92
Koppers Company, Inc. 78
Kurz & Root Co. 95

Lanova Corp. 95
Lima-Hamilton Corp. 23
Lister-Blackstone, Inc. 74

Mack Manufacturing Corp. 12
Magnus Chemical Co., Inc. 92
Manzel, Division of Frontier Industries, Inc. 88
Marquette Metal Products Co. 26
Maxim Silencer Co., The 75

National Welding & Grinding Co. 94

Oakite Products, Inc. 86

Pesco Products Div., Borg-Warner Corp. 17
Petrometer Corp. 95

Reiner & Co., John 93
Rockford Clutch Div., Borg-Warner 76
Ross Heater & Mfg. Co., Inc. 21

Schoonmaker Co., A. G. 94
Sealed Power Corp. 14
Sheppard Diesels 93
Sinclair Refining Co. 15
Standard Oil Co. of Calif. 5
Standard Oil Co. (Indiana) 11
Standard Pressed Steel Co. 94
Standard Stoker Co., Inc., The 84
Sterling Engine Co. 79
Struthers Wells Corporation 89
Synchro-Start Products, Inc. 78

Texas Co., The ..... Second Cover-1
Thomas Flexible Coupling Co. 90
Tide Water Associated Oil Co. 73
Tuthill Pump Company 93
Twin Disc Clutch Co. 27

Union Diesel Engine Co. 91
U. S. Hoffman Machinery Corp. 83

Van Der Horst Corp. of America 77
Vellumoid Co., The 95

Walworth Co. 22
Waterbury Tool Div., Vickers, Inc. 89
Westinghouse Electric Corp. 8-9
Woodward Governor Company 65

Young Radiator Co. 85

. . . at the New ALCOA PLANT!

Forty Elliott generators, driven by these Nordberg vertical radial gas engines, supply their share of the large electric power capacity required in the production operations of the Aluminum Company of America at their Point Comfort, Texas, plant.

The entire operation is epoch-making in nature, involving engineering development along new lines. The Aluminum Company of America co-operated with the Nordberg Manufacturing Company in developing the vertical radial engine, while Elliott Company engineers, who pioneered the invention of the fully compensated d-c generators used, designed special vertical generators to deliver 1100 kw of direct current, with additional take-off of 150 kva of alternating current for auxiliaries.

In the making of aluminum, the huge amount of power required makes economy of operation, continuity of service and low maintenance of vital importance. The excellent operating record of Elliott generators since this plant was placed in service confirms the good judgment of the original selection of Elliott generators.

J-720

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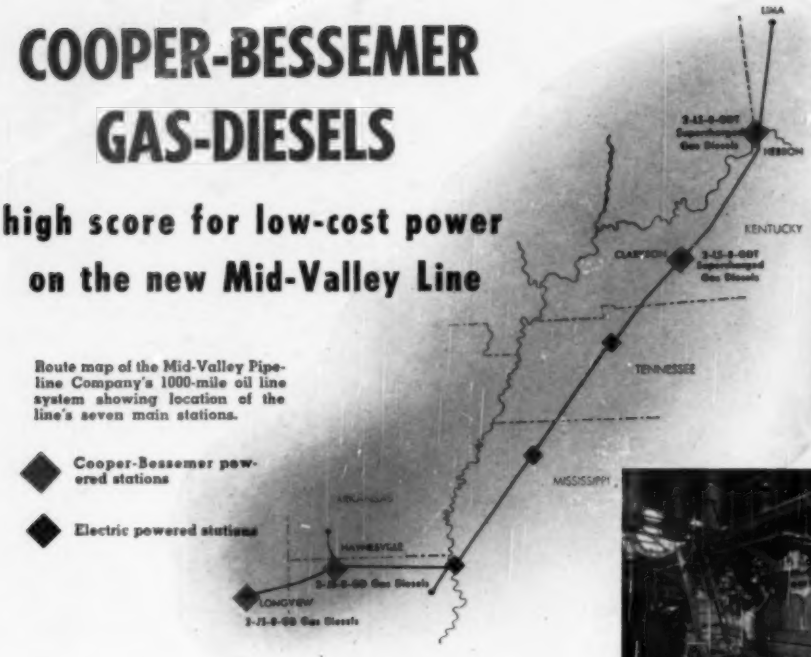
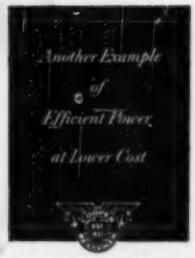
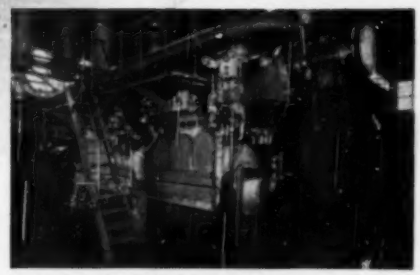


Route map of the Mid-Valley Pipeline Company's 1000-mile oil line system showing location of the line's seven main stations.

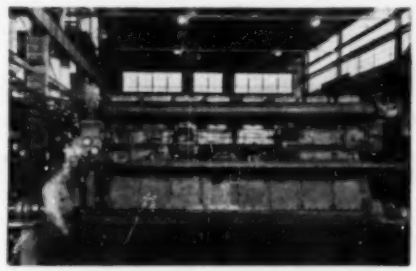
◆ Cooper-Bessemer powered stations

◆ Electric powered stations





B. F. Relf of Mid-Valley checking a supercharged LS-8 gas-diesel, rated 1715 hp at 327 rpm on the Cooper-Bessemer erection floor. Mid-Valley's Clarkson and Hebron stations in Kentucky will each be powered by two of these modern engines.



C. N. Brindley of Mid-Valley checking a JS-8 gas-diesel, rated 800 hp at 450 rpm on the Cooper-Bessemer erection floor. Units of this type will power Mid-Valley's Longview, Texas, and Haynesville, La., stations—two engines for each station.

WHEN put into operation this Fall, Mid-Valley will be the most modern, most economical of the nation's cross-country oil lines. Highly significant, thorough studies proved that a combination of four gas-diesel powered stations and three electric powered stations assured peak economy. Modern, exceptionally efficient Cooper-Bessemer gas-diesels were picked for the job, will be located as shown on the map.

The smooth operation of Cooper-Bessemer gas-diesels on oil or any combination of gas and oil, means maximum flexibility and uninterrupted service. Even if the gas supply fails completely, these engines will continue to run, fueled by oil bled directly from the line.

If you have power needs coming up, you'll be wise to check into Cooper-Bessemer's latest money-saving engine developments — such as supercharged gas engines and gas-diesels . . . new gains in the power-to-space ratio of oil-burning diesels . . . and supercharged Turboflow compressor engines. Just get in touch with the nearest Cooper-Bessemer office.

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